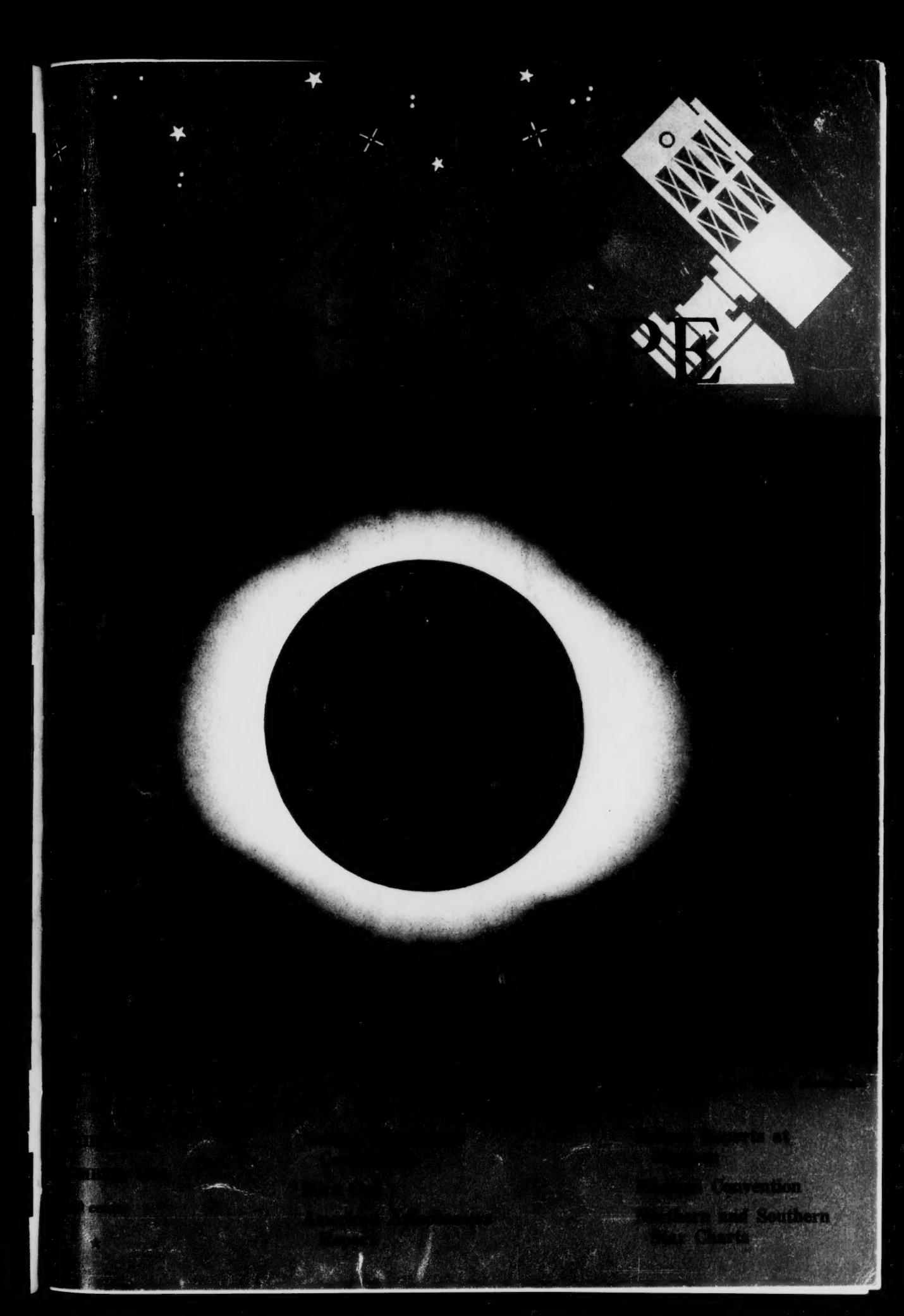

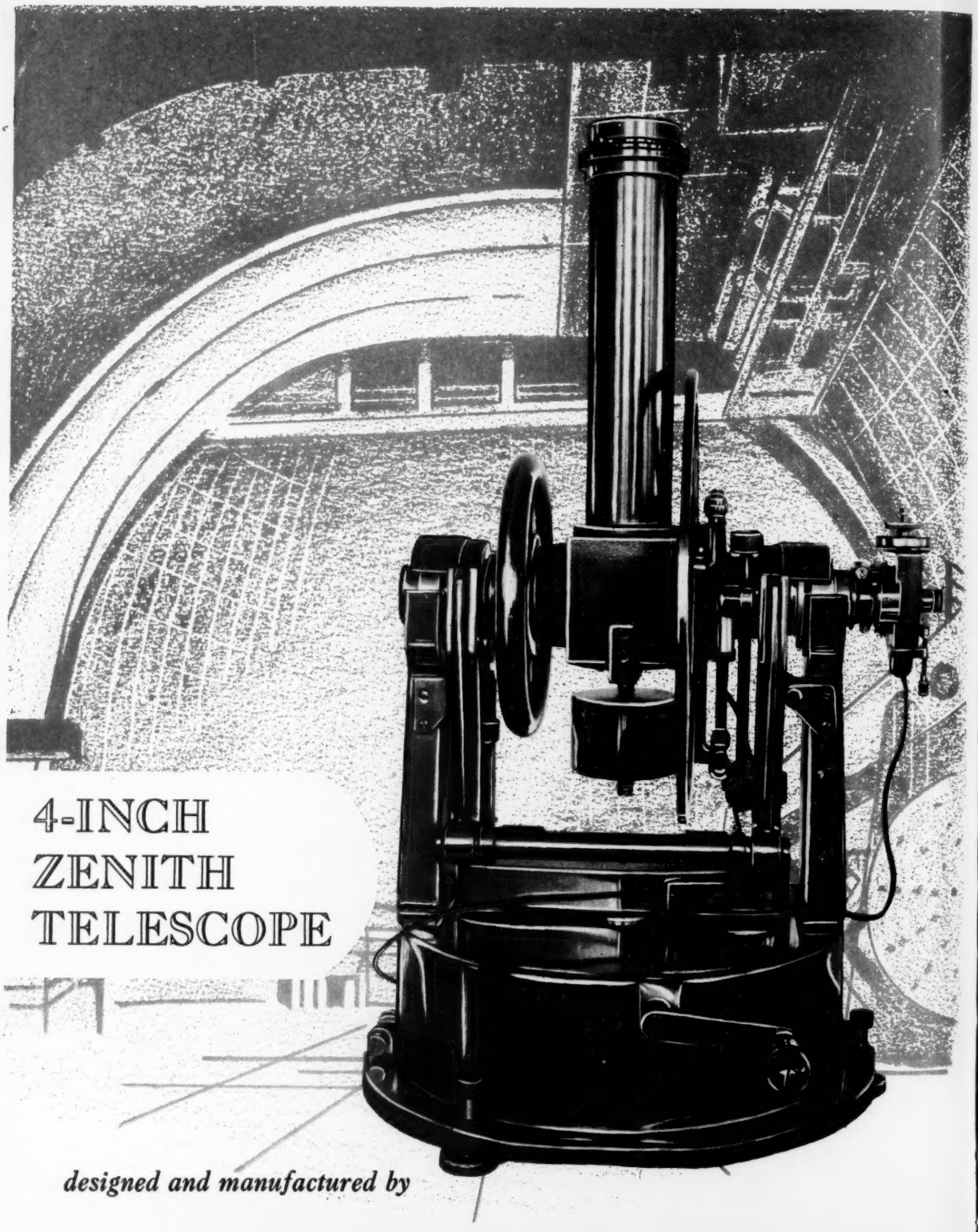

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Sky and TELESCOPE

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LETTERS

Sir:

One day I boarded a rather crowded New York Central train at Springfield, Ohio, and sat next to a young man. He soon pulled a paper-bound book from his pocket, perhaps four by six inches, about an inch thick. To my amazement, it was evidently a book on the constellations, with rather distinctive illustrations. Each constellation seemed to be treated in a separate chapter, the illustration showing the group of stars surrounded by the constellation figure itself as drawn by the ancients. The book contained star maps also.

I intended to ask to see the book and possibly to thumb through it, but he got out at the next stop. So I do not know the title of the volume, its author or its publisher. I visited newsstands, scrutinized advertisements, wrote three New York publishers of pocket editions, consulted the **Cumulative Index,** and ordered one book I thought might be it, but with no luck. I would certainly be grateful if one of your readers might identify the book for me.

CLARK RAYMOND WARD
Gallaher Drug Store
Fostoria, Ohio

Sir:

Our observatory has an unmounted parabolic mirror of 123 centimeters (48.4 inches) diameter, made by Schaer of Geneva from St. Gobain glass, which it intends to sell. The focal length and thickness are 633 and 20 centimeters (249.2 and 7.9 inches), respectively, and it does not have a central hole. Inquiries may be addressed to the undersigned.

W. BECKER
Basel University Observatory
Binningen, Switzerland

Sir:

T. S. Jacobsen's article on the green flash, in July, 1953, was of great interest.

The green flash has been a familiar phenomenon to me for many years, and on occasion I have seen it very clearly. The Gulf of California is a favorable region, along the coast of the Mexican state of Sonora. In the latter part of May, 1953, I was on the mudflats there at sunset with a young man named Snyder. As an experiment I asked him to watch the sun intently as it dropped into the sea. I saw a very vivid green flash just at the instant the final edge disappeared. When I asked Snyder if he saw anything, he said, "I sure did; what was all the green light about?" He had never heard of the green flash before.

This year, about two miles inland from the gulf and some 50 or 60 feet above sea level, I watched through binoculars as the sun sank into the sea, and noticed one or two features I had not seen before. This time there was not much indication of a green flash, but instead a brilliant blue flicker at the top of the sun's disk,

Mr. Sykes' drawing, of the setting sun, made on April 16, 1954.

as shown in the sketch. This flicker was at an earlier stage in the sunset than that at which the green flash is customarily observed. The distortion of the sun's shape by refraction irregularities was also of interest.

GLENTON G. SYKES
1622 E. 4th St.
Tucson, Ariz.

Sir:

At Portage Lake Observatory, we procured an Ektachrome (color) objective-prism photograph of a portion of the Hyades cluster, with the Curtis Schmidt telescope. The original is a one-hour exposure, on which the spectra are 15 millimeters long and 1.7 wide.

We have made transparencies on 8-by-10-inch Ektachrome of the entire field, five degrees or 7½ inches in diameter, at the scale of the original. Standard sized lantern slides (3¼ x 4 inches), on Ektachrome, and 2 x 2 slides, on Kodachrome, cover the richest three quarters of the field.

Examples of each style of reproduction were on display here at the June meeting of the American Astronomical Society, and in response to the interest manifested at that time we have arranged to make them generally available through our photographic service department.

The costs, including mailing charges, are: Kodachrome 2 x 2 slide in ready mount, $1.00; Ektachrome 3¼ x 4 slide bound in glass, $2.50; Ektachrome 8 x 10 transparency, $7.50. Orders should be addressed to Photographic Services, University of Michigan, Room 526 Administration Bldg., Ann Arbor, Mich.

Each order should state the type of reproduction desired of "Hyades spectra." Orders from individuals must be accompanied by a check payable to the University of Michigan. Purchase orders from institutions will be sufficient.

FREEMAN D. MILLER
University of Michigan Observatory

VOL. XIII, NO. 11

CONTENTS

SEPTEMBER, 1954

COVER: The corona of the sun, as it appeared at the total eclipse of June 30, 1954. This photograph by Roland Rustad, Jr., has been awarded first prize in the **Sky and Telescope** eclipse photograph competition. It was taken with a 3-inch f/13.3 refractor, motor driven during an exposure of three seconds. (See page 364.)

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FEATURE PICTURES: The winning pictures in the **Sky and Telescope** eclipse photograph competition comprise the pictorial feature this month. (See the front cover and pages 364 through 367.)

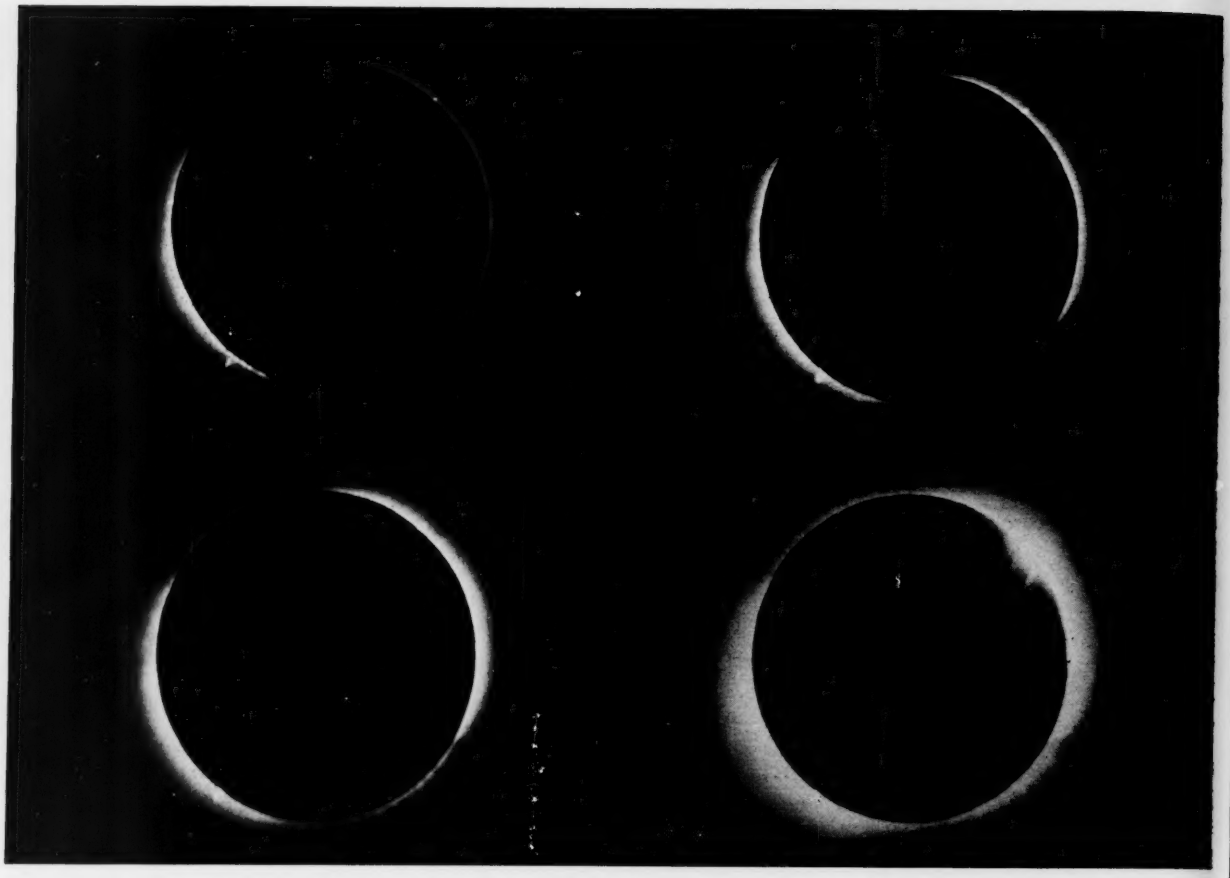
SKY AND TELESCOPE is published monthly by Sky Publishing Corporation, Harvard College Observatory, Cambridge 38, Mass. Entered as second class matter, April 28, 1939, at the Post Office, Boston, Mass., under Act of March 3, 1879; accepted for mailing at the special rate of postage provided in Paragraph 4, Section 538, Postal Laws and Regulations.

Subscriptions: $4.00 per year in the United States and possessions; $7.00 for two years; $10.00 for three years. Add $1.00 per year for Canada and for all other foreign countries, including Latin America, making the total subscription $5.00 per year, $9.00 for two years, and $13.00 for three years. Canadian and foreign remittances should be made in United States currency. Single copies, 40 cents, foreign 50 cents. Circulation staff: Nancy R. Bolton, manager; Virginia K. Cox.

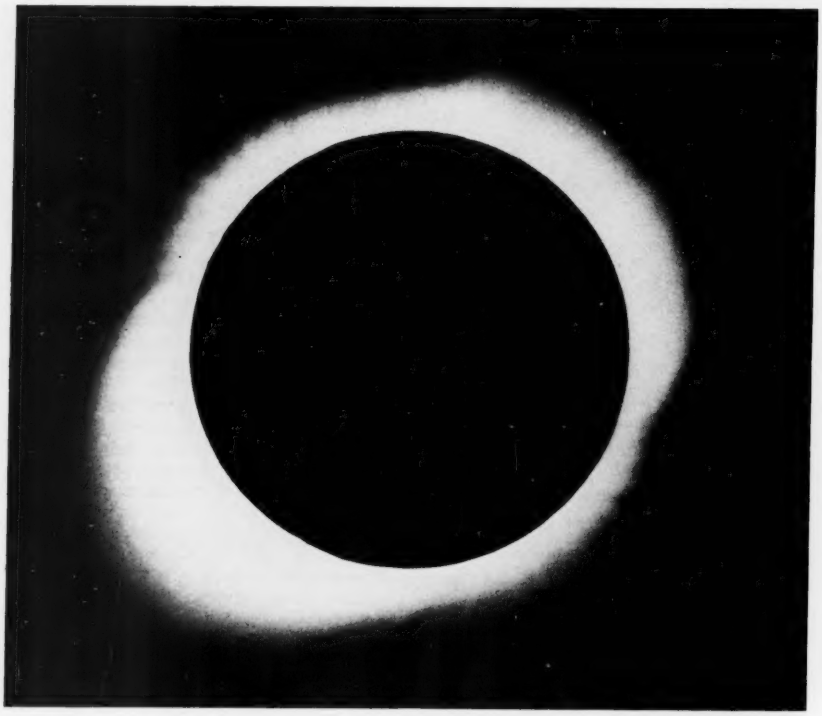
All notices of change of address must be sent one month in advance and accompanied by old and new addresses, or we cannot make the proper change. When sending your renewal order, or writing in regard to your subscription, your current mailing address must be given. For most efficient handling of your subscription, please return our bill form with your renewal payment.

Editorial and advertising offices: Harvard College Observatory, Cambridge 38, Mass. Unsolicited articles and pictures are welcome, bearing adequate return postage, but we cannot guarantee prompt editorial attention, nor are we responsible for the return of unsolicited material.

The principal articles in SKY AND TELESCOPE, beginning with Vol. XII, are indexed in THE READERS' GUIDE TO PERIODICAL LITERATURE.



These are four of the series of seven pictures, taken by A. W. Horst, that tied for second prize. Exposures were 1/100 second for upper left; 1/50, upper right; 1/25, lower left; and ½ second, lower right. The intervals between these pictures were 30, 20, and 10 seconds.



Expedition Blackout's 12-foot camera took this second-prize photograph at Ironwood, Mich., half a second exposure at f/29.

ECLIPSE

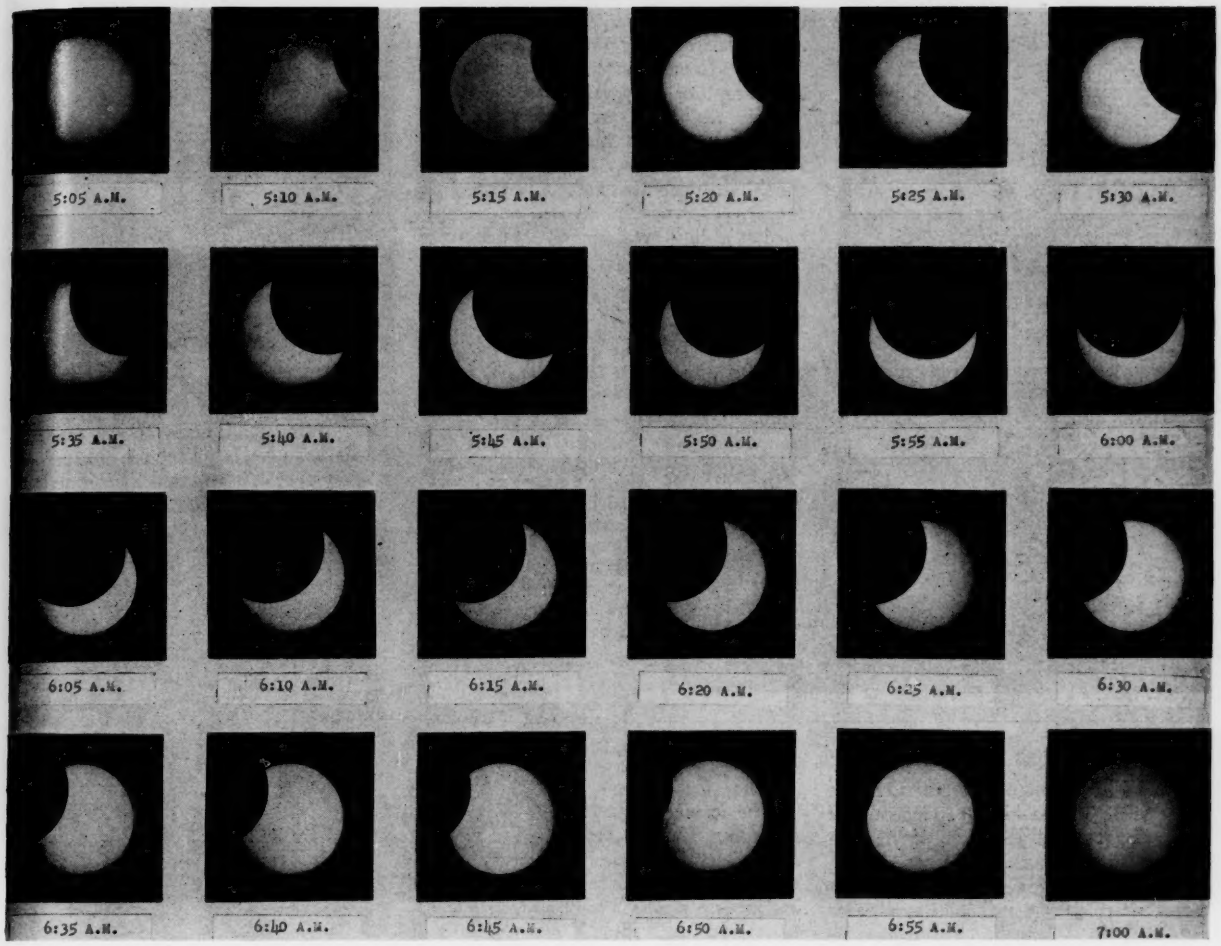
First Prize — The Front Cover

THE TWO PICTURES I am submitting, one of the corona and the other of the diamond ring, are in my estimation the most interesting of nine that I took of the partial and total phases. They were made with a 3-inch refractor of 40-inch focal length, on a portable equatorial mount of my own design. The telescope drives by a wind-up phonograph motor. A 35-mm. camera body was placed at the prime focus, where the sun's diameter was ⅜ inch.

The corona photograph (see the front cover) was taken at f/13.3 on Super XX, 3-second exposure, and processed in Microdol in my own darkroom.

I am 23 years old, and my 3-inch telescope is my second one. Its objective is a government-surplus lens mounted in an aluminum tube, which has fastened to it my first telescope, a 2-inch refractor. For photography with the 3-inch, I use the 2-inch for guiding.

Roland Rustad, Jr.
4236 Linden Hills Blvd.
Minneapolis 10, Minn.



The third prize was awarded to this series of the partial eclipse, taken by John F. Bicking at Gloucester, N. J.

PHOTOGRAPH COMPETITION

TIE FOR SECOND PRIZE — THE SERIES

AT IRONWOOD, Mich., a sequence of seven pictures was taken at approximately 10-second intervals, with exposure times of 1/100 second for the first and second, 1/50 for the next two, 1/25 for the fifth and sixth, and about ½ second, bulb, for the last shot. The film was Super XX, in a 35-mm. Exa single-lens reflex camera attached to my 8-inch f/8 reflector; no eyepiece or camera lens was used.

It was the shortest 70 seconds we ever experienced. I had hoped to get several longer exposures, but time ran out. A similar set was taken with a 155-mm. telephoto lens on another camera, giving, of course, much smaller images. The weather was perfect in spite of thunderstorms the night before. Shadow bands showed up quite well against the side of the car. I am a member of the Fox Valley Astronomical Society.

A. W. HORST
708 Anderson Blvd.
Geneva, Ill.

TIE FOR SECOND PRIZE — THE CORONA

EXPEDITION BLACKOUT would like to enter this corona photograph in the competition. [For details of the expedition, see next month's issue.] The photograph was taken at Ironwood, Mich., at the Gogebic County airport, with a 12-foot long-focus objective mounted in cardboard tubing. A 4 x 5 Graflex camera was attached to the other end of the tube, and was used for focusing the solar image and supporting filmholders. A shutter attachment over the lens was actuated by an air bulb.

The exposure was about ½ second at f/29 on 4 x 5 Kodak Royal Pan cut film, developed in D76 for 17 minutes. William Glenn made the exposures; Edward Oravec changed filmholders; and I built the instrument, supervised its use, and processed the film at our motel right after the eclipse.

CHARLES CUEVAS
48-16 38th St.
Long Island City 1, N. Y.

THIRD PRIZE—THE PARTIAL ECLIPSE

THE SERIES was made with a 6-inch reflector. A shutter with a maximum aperture of ⅝ inch was placed at the upper end of the tube; the minimum shutter time was 1/175 second and the maximum one second.

After reflection by the primary mirror and subsequently by the prism, the light passed through a filter approximately four inches forward of the prime focus. This filter transmitted 0.32 per cent of the incident light, as determined by test photos made over several days.

When the shutter was opened to maximum aperture, the focal ratio was f/70 (focal length 44 inches, aperture ⅝ inch). For all purposes this figure could be rounded off to f/64. The experimental photos indicated that the combination described would give best results at f/64, 1/800 second, using Isopan film. But since the shutter speed went only to 1/175, another filter was introduced that transmitted 25 per cent incident light.

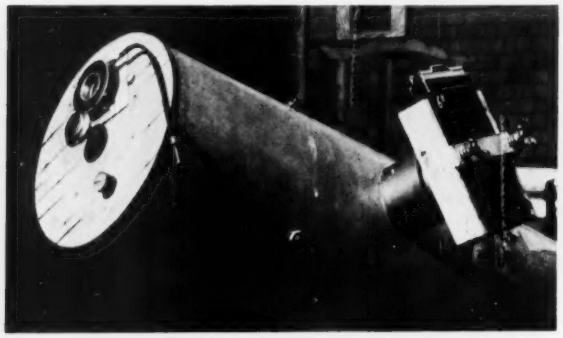
Photographs were made on the morn-

ing of the 29th at eclipse time. There was a medium haze at 5 a.m. when the trial photos were begun. The first step was to eliminate the 25-per-cent filter, which obviously would be useless at any time before 8 or 9 o'clock on an average day.

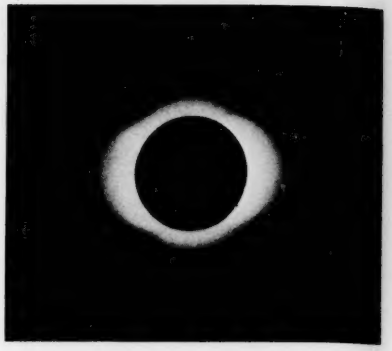
On the morning of the 30th there was extreme haze, and my trial exposures were increased, making the 5:00 exposure f/64 at ½ second. The 5:05 exposure was ½ second; 5:10, 1/5; 5:15, 1/10. From 5:20 through 5:45, I used 1/25 second, and from 5:50 through 6:35, 1/50. At 6:40 there was a general clearing of the haze, and exposures were shortened to 1/100 second; at 7:00, 1/175 was used.

The negatives were developed in Ansco 17 medium fine-grain developer for eight minutes, the recommended time. All, with the exception of the first four, were properly exposed and developed, yielding good prints. They were projected on Velour Black R-2 and developed in Dektol at standard dilution. The images on the negatives are about 0.4 inch in diameter.

JOHN F. BICKING
817 Middlesex St.
Gloucester, N. J.



This apparatus was used by Mr. Bicking to photograph the partial eclipse series. Note the adaptation of a camera shutter, and the wing nuts holding the camera back to the eyepiece drawtube.



Edward J. Conley's corona picture.

for 15 minutes. The print was made on Medalist (F-3) projection paper, exposed 75 seconds and developed one minute in Dektol, with the enlarger set at f/13.

I am a senior at Fenwick High School in Oak Park, Ill., and president of our school astronomy club. Our field trip this year was an eclipse expedition, for part of which we procured finances from the school treasury.

EDWARD J. CONLEY
1712 N. 77th Court
Elmwood Park, Ill.

HONORABLE MENTIONS

FOURTEEN pictures were taken on a hill overlooking Independence Lake, about 20 miles west of Minneapolis, using a homemade camera designed especially for the eclipse. It has a single-element, 3-inch objective with a 75-inch focal length. The camera is equatorially mounted. Focusing is accomplished by tightening or loosening thumb screws on threaded rods on the sides of the camera near the rear section. Mounted on the front is a 4-inch shutter, bulb controlled. For pictures of the partial phases, a second shutter was used which operates at 1/25 second and up to f/500.

The Kodak Super Panchro-Press, type B, 4 x 5 sheet film was developed in Durol-7. Enlargements were made on Kodabromide, F-3 and F-4 contrasts, and developed in Dektol. The photograph shown was enlarged from a shot of the diamond ring phase preceding totality, 1/3 second at f/25.

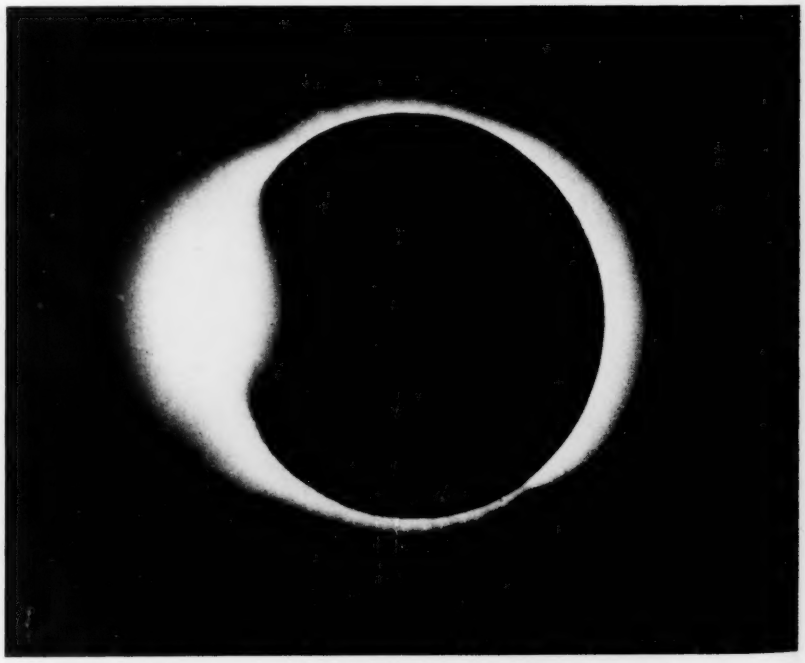
I am a junior in Lourdes School in Rochester, and a member of the junior academy of science.

THOMAS O'BRIEN
25-13 Ave., S.E.
Rochester, Minn.

MY SHOTS of totality were taken near Glidden, Wis., just a few miles south of the central line. I used a 4 x 5 plate camera with an f/3 orthographic lens, focal length about six inches. Since this lens was a double-element type, I merely removed one of the elements, thereby increasing the focal length and getting a much larger image in the focal plane of the camera.

The camera was on an equatorial mounting which I formerly had for my 4-inch rich-field telescope; this allowed the camera to follow the sun by moving around one axis only, greatly adding to its stability. Plus X safety film was used; the camera was at f/25 at 1¼ seconds. Development was in Microdol

THE SUN, as it rose eclipsed near Milltown, Wis., was photographed through a Bausch and Lomb 20x telescope, with a Robot Star 25- by 25-mm. camera, on Super XX film at f/22, 1/100 second. A large war-surplus neutral filter of unknown density was placed ahead of the telescope. Develop-



A relatively long exposure of the diamond ring phase at second contact was taken by Thomas O'Brien, and was awarded an honorable mention in the contest.

The rising sun already partially eclipsed, by Theo. Skonnard.

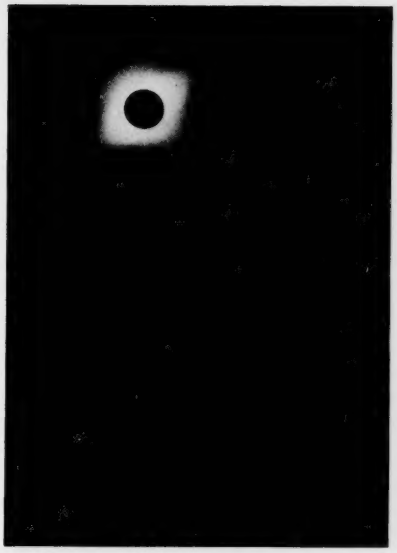
ment was in Microdol. The tree to the right of the sun was about two miles away.

For the partial phases and totality, I used a camera of my own manufacture, equipped with a war-surplus 4-inch aero telephoto lens of 19-inch focal length, no filter. Several of the pictures were taken by my 13-year-old son, John.

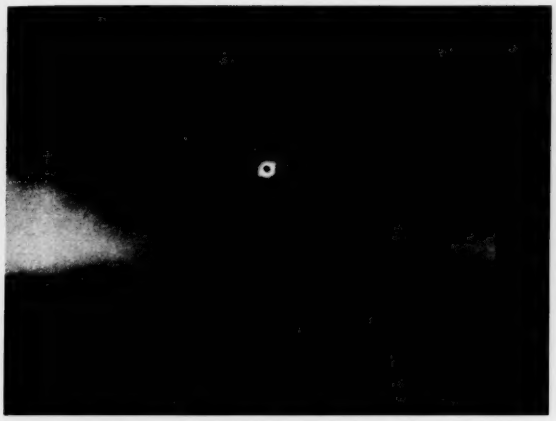
THEO. SKONNARD
1436 Sixth Ave. So.
Fargo, N. D.

WE OBSERVED from five miles northwest of Minneapolis, at the junction of U. S. highway 52 and county road 8, at an elevation of 880 feet. The homemade camera, without clock drive, has an Aerostigmat lens of 20-inch focal length at f/5. The film was Super Panchro-Press, type B, developed in Microdol for 13 minutes. Two exposures were made within 10 seconds of one another, and both were good.

G. R. WRIGHT
202 Piping Rock Dr.
Silver Spring, Md.



The outer corona, set off by the local landscape, by G. R. Wright.



This picture shows well the wedge shape of the shadow. It was made from a fire tower by Dan Davis, Jr.

A 72-foot fire tower near Spooner, Wis., was our observing station [see page 374 for more details]. The totality shot was made with a Hawkeye Brownie camera, with a 5-second exposure on Super XX. The print was "burned in" to get the maximum effect of the corona and shadow, losing detail in the ground below.

DAN DAVIS, JR.
Box 536
Childress, Tex.

ED. NOTE: No award was made in the special-interest class. Two second-prize awards were given.

PARTIAL ECLIPSE AT 21 CENTIMETERS

The accompanying record obtained with the new radio telescope at the Agassiz station of Harvard Observatory shows how the brightness of the sun varied during the 75-per-cent partial eclipse, at a wave length of 21 centimeters. Two vertical markers indicate the interval between first and last contacts predicted for ordinary visual observations.

Clearly, the eclipse lasted longer by radio than in visual light, indicating that the solar area in 21-cm. radiation is larger than the sun's optical area. Last contact by radio, determined from the point where the sun has just reached maximum intensity, on the right edge of the tracing, occurred some 10 minutes later than the optical last contact. First contact was not so well defined, because the sun was low in the sky and partially obscured by trees.

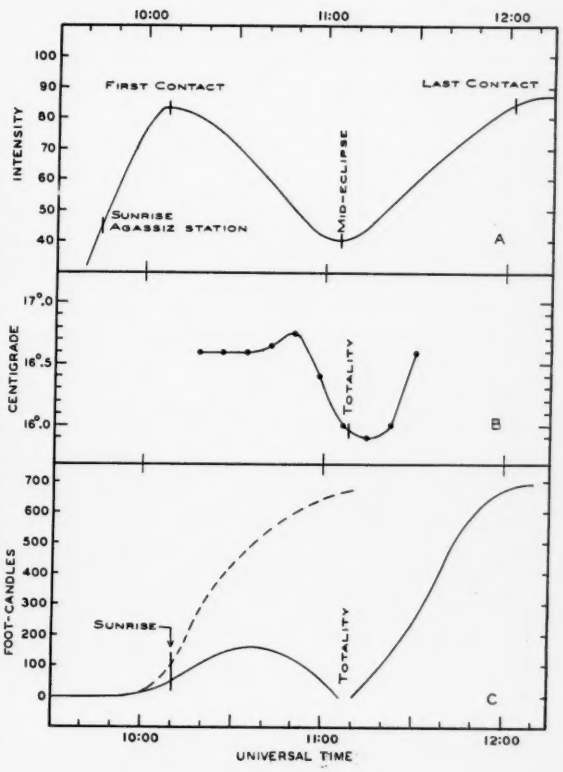
The observations were made by Dr. Harold I. Ewen, John A. Campbell, Campbell M. Wade, and T. K. Menon. Mr. Menon, a graduate student at Harvard, is studying various models for the structure of the outer layers of the sun.

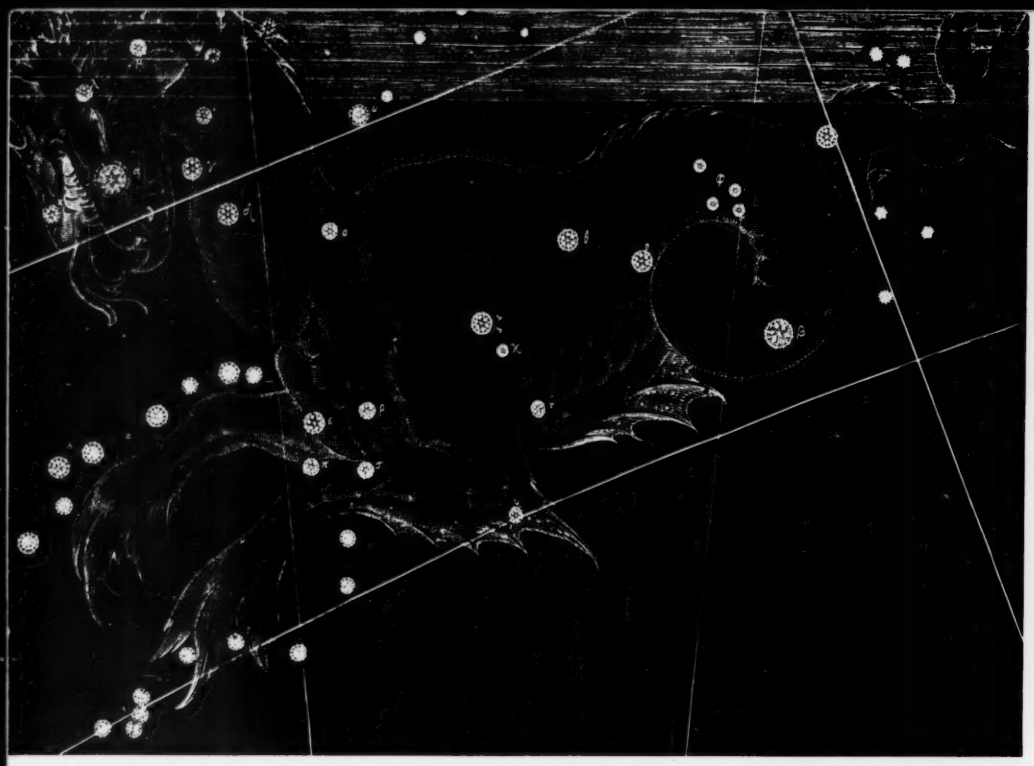
RADIO, TEMPERATURE, AND SKY BRIGHTNESS OBSERVATIONS

A. At Harvard's radio telescope in Massachusetts, the partial eclipse produced a decided decrease in the intensity of solar radiation at 21 centimeters wave length. Optical contacts are marked.

B. Members of the Junior Astronomy Club of Minneapolis recorded temperature changes at 8-minute intervals. Their eclipse program is reported on page 380.

C. Near Ironwood, Mich., Armand Spitz and his group used photometers to measure the brightness of the zenith sky (see page 375). The dashed line shows the previous morning's readings. At totality, the light was too feeble to operate the meters.





MIRA CETI

By Otto Struve

Leuschner Observatory, University of California

This picture of Cetus, the Whale, is from Bayer's "Uranometria." Mira is Omicron in the constellation, situated in the base of the neck of the animal. In the lower left portion of the chart are many stars of Eridanus, the River.

SIR JAMES JEANS once wrote, "It is usually the totally unexpected that happens in science, — the unaided human mind can seldom penetrate far into the darkness which lies beyond the small circle of light formed by direct observational knowledge."[1]

One of the most remarkable demonstrations of the truth of this statement occurred 32 years ago when A. H. Joy discovered the binary nature of the famous long-period variable star, Mira, in the constellation of Cetus. Among the many other unexpected discoveries that we have witnessed in these three decades, Joy's work on Mira Ceti stands out as a perfect example of a discovery requiring a unique combination of observational skill and critical ability to recognize a new feature and to interpret it correctly.

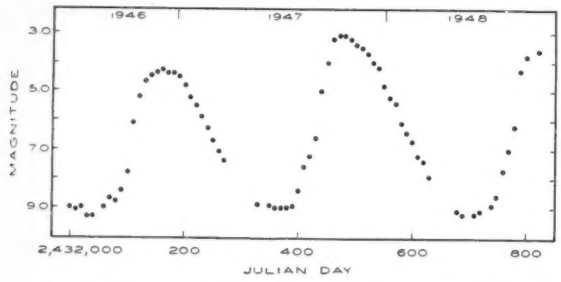


Fig. 1. In this light curve of Mira for the years 1946 - 1948, the plotted points are 10-day means of observations by members of the American Association of Variable Star Observers.

Mira was discovered as a variable star by David Fabricius, in 1596. On the night of August 13th of that year, he found it to be brighter than the 2nd-magnitude star Alpha Arietis. In September and October, the star in Cetus declined in brightness and finally vanished altogether from sight. Fabricius again observed Mira in 1609, but apparently he did not establish the periodicity of its light variation. James Ferguson wrote in 1756 that Mira "[is] found to appear and disappear, periodically, seven times in six years, continuing in the greatest lustre for fifteen days altogether, and is never quite extinguished."[2]

A modern light curve of Mira is shown in Fig. 1. The star's apparent visual magnitude reaches between 2 and 5 at maximum (once even attaining 1.2, in the year 1779), and drops to between 8 and 10 at minimum. The period is not constant, but averages about 330 days. The spectral type is about *M*6 at maximum light and *M*9 at minimum.

Radiometric observations by E. Pettit and S. B. Nicholson have shown that the surface temperature of Mira is about 1,900° absolute at minimum brightness and 2,600° absolute at maximum. The ratio of these temperatures is 1.37. According to Stefan's law, the total radiation per square centimeter of surface is proportional to the fourth power of the temperature. Therefore, at maximum, each unit of Mira's surface radiates $1.37^4 = 3.5$ times as much light and heat as at minimum. Yet the visual or photographic range in the star's light is about five magnitudes — a hundredfold.

Several effects appear to account for this difference. First, the visible radiation increases with temperature by a larger factor than the total radiation, as shown in Fig. 2. Second, the star pulsates, but the radial motions outward and inward are rather small, corresponding to a change in radius of perhaps 20 per cent — a difference of surface area of 1½ times. But these considerations together account for only a part of the observed total change in light.

The remainder may be caused by a strengthening of the dark absorption

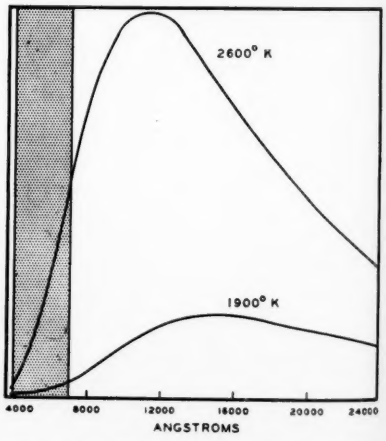


Fig. 2. A change in temperature from 1,900° to 2,600° absolute increases the total radiation of a black body 3½ times. In the visible region, shaded in this diagram, the relative increase is much greater.

1. Quoted by P. W. Merrill in *The Nature of Variable Stars*, Macmillan, New York, 1938, page 105.

2. Quoted by William Herschel, *Collected Works*, 1912, Vol. 1, page 1.

bands and lines in the spectrum when the star is faintest, and perhaps by increased veiling by temporary high-level clouds of solid or liquid particles. The presence of such clouds has long been suspected. In typical carbon-type variables like R Coronae Borealis the clouds may consist of "soot" (*Sky and Telescope*, August, 1953, page 265). In ordinary *M*-type red stars the character of the cloud particles is uncertain, but John Phillips at Berkeley has recently suspected the presence of water vapor bands in some very cool stars. The possibility of the formation of water molecules was pointed out long ago by H. N. Russell. It may turn out that stars like Mira Ceti are surrounded by clouds of variable thickness, consisting of ice crystals or of water droplets.

The angular diameter of Mira was measured by F. G. Pease in 1925 with a large interferometer at Mount Wilson. The result was 0.056 second of arc, corresponding to nearly 300 times the diameter of the sun if the star's parallax is 0.02 second, a value recently adopted by P. P. Parenago, mostly from the early trigonometric observations by S. Kostinsky at Poulkovo.

Mira's spectroscopic behavior is extremely complicated. Joy described its main features in a long article in the *Astrophysical Journal* during 1926. A wealth of new facts has recently been described, also by Joy, from observations made with a dispersion of 2.3 angstroms per millimeter with the 200-inch telescope; this work has just been printed as *Supplement No. 2* of the *Astrophysical Journal*. A detailed comparison of Mira Ceti with other long-period variables was presented by P. W. Merrill in his book, *Spectra of Long-Period Variable Stars*, 1940. It is not our purpose here to review these features in detail, but to discuss a major problem involved in the spectroscopic analysis.

In the red region of Mira's spectrum (Fig. 3), the absorption bands of titanium oxide predominate. In the photographic region, the spectrum is full of atomic and molecular absorption lines. There are also strong emission lines of hydrogen, with the characteristic absence of Hε in the violet, which is blotted out by overlying vapor forming the strong H line of ionized calcium. Other emission lines of hydrogen are similarly distorted by overlying absorption lines of iron and other elements.

Clearly, from this evidence, the emission lines of hydrogen originate fairly deep inside the uppermost photospheric layers of the star. Perhaps they are produced in, or slightly above, the convection zone of hydrogen, where there is circulation of the star's gases.

The size of the gaseous atmosphere with its clouds of small particles is unknown, but from the complexity of the spectroscopic variations it is reasonable

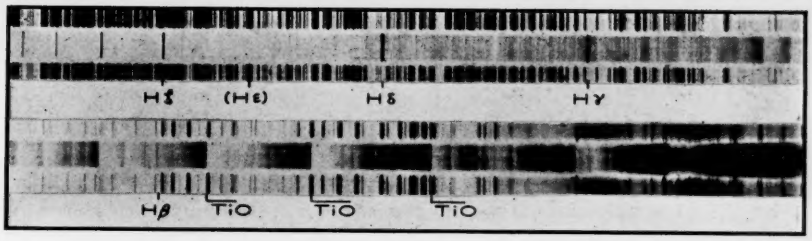


Fig. 3. In this McDonald Observatory spectrum of Mira, the bright emission lines appear dark; absorption lines and bands are bright. The upper portion is the blue region, with hydrogen emission lines labeled.

to conclude that its radial extent is enormous, even when compared to the radius of the star as measured with the interferometer. Moreover, in the related case of the double-star variable VV Cephei, D. B. McLaughlin and I concluded independently that the entire system of hundreds or thousands of astronomical units extent is embedded in a tenuous nebulosity, producing strong absorption lines. We may thus believe that red supergiants are often surrounded by such exceedingly widespread gaseous masses, and it is not impossible that the partial pressures of some of the gases are such that they can, at times, condense into solid or liquid particles, as mentioned above.

Undoubtedly, the mechanism that underlies all of these changes is a pulsation of the whole star, or at least of its outer layers. If we estimate the mass of Mira as 10 times that of the sun, its average density is about 100 million times smaller than the average solar density. A gas sphere of such a low density would of necessity pulsate very slowly; its period would be just about one year (see *Sky and Telescope*, March, 1953, page 120). But since neither the light curve nor any of the spectrographic features repeat themselves from cycle to cycle, we must assume that in the long-period variables (and probably in ordinary Cepheids, too) the strictly periodic pulsation acts as a trigger mechanism for various more-or-less irregular atmospheric phenomena — somewhat resembling the interrelation between cyclical variations of solar radiation and induced changes of terrestrial weather.

Until 1923 Mira Ceti was believed to be a single star. In vain had visual observers of great experience repeatedly examined Mira to see if it was a close double. They also had measured it with respect to two distant, optical companions; Mira itself has a large proper motion, and any physical companion would share this motion.

Joy started his spectrographic study in 1916 with the 60-inch reflector at Mount Wilson. When Mira was at minimum brightness in 1918, and especially in 1920, he noticed that the centers of all strong absorption lines and bands of the red *M* star were not clear photographic film, but were filled with a continuous spectrum whose intensity increased toward the violet as in a blue *B* star. Joy also noticed that the hydrogen lines were made up of very strong emission components, with absorption centers. These lines were not the same at different minima: Sometimes they resembled the hydrogen lines of P Cygni, in which the gas expands rapidly in all directions from the star. Joy concluded that Omicron Ceti has a composite spectrum — in addition to the usual *M*-supergiant spectrum there is a peculiar 10th-magnitude *B*-type spectrum. But at first there seemed no possibility of resolving these two light sources visually.

However, when the 100-inch telescope came into operation in 1919, its new Cassegrain spectrograph was so constructed that it could be rotated in position angle. Joy soon noticed that when the slit was placed in position angle 135°-315°, the *B* spectrum appeared very slightly displaced with respect to the *M* spectrum, especially when the visible (single) star image was not permitted to trail on the slit. In position angle 45°-225° there was no such displacement; in fact, it seemed that the *B*-type features were then mostly off the slit, except for the effect of bad seeing (Fig. 4). The interpretation of these

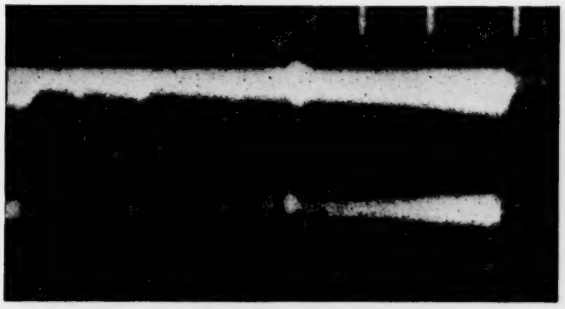


Fig. 4. In these positive prints of Mira spectra by A. H. Joy, the hydrogen-beta emission line is displaced upward in the lower spectrum, taken at a slit orientation of 135°-315°. The upper spectrum was made with the slit at right angles to this.

observations is shown below in Fig. 5.

Joy stated in 1922-23: "Although Professor Barnard failed to resolve the star under bad conditions of seeing, the impression of duplicity gained in strength." He estimated the position angle of the pair as 135° and their separation as 0.3 second of arc.

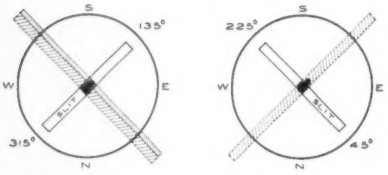


Fig. 5. Left: Both Mira and companion are on the slit, and give spectra (hatched). Right: The B star is off the slit, and its spectrum is missing.

In 1923, Joy wrote to R. G. Aitken at the Lick Observatory and asked him to examine Mira during the minimum of its light in October. On the 19th of that month Aitken found the blue companion visually, and its position angle was 130°, almost precisely the value estimated by Joy. But Aitken found the distance between the stars to be 0.9 second.

The discrepancy between this value and Joy's estimate of only one-third as much has not been fully cleared up. At first it was thought by some astronomers to represent orbital motion, but at the time Joy quickly discouraged these ideas, and he accepted Aitken's measurements as representing, with sufficient accuracy, all of his own spectroscopic results.

I remember, however, that when G. Van Biesbroeck, at the Yerkes Observatory, learned of Joy's discovery and of Aitken's visual confirmation of it, he deduced for the companion a strongly elliptical orbit, with a relatively short period of a few years. The basis for this orbit was the dates in the past when competent double star observers had recorded Mira as single, despite the fact that the light of the long-period variable was then at minimum and the companion should have been easily detectable.

This tentative orbit was never published, however, because Joy had already recognized another remarkable property of the blue companion: It varies in light, independently of the red supergiant's variation, with a range of about two magnitudes. Hence, it was to be expected that at some of the *M* star's minima the *B* companion was invisible because it was too faint, rather than because it was too close to the primary as would be required by Van Biesbroeck's orbit.

The light curve of the companion is shown in Fig. 6, taken from Joy's recent paper. The open circles at the top are by Van Biesbroeck; the solid dots represent estimates by several other double star observers. The crosses are Joy's own estimates from the relative intensities of the *B* and *M* spectra. Both series indicate minima in brightness of the companion in 1928 and 1942, with an indication of an earlier minimum in 1914 and one to be anticipated in 1956. There may, thus, be a periodicity of 14 years in the blue star's light variation.

The problem of Mira's orbit was reviewed by P. Baize in 1939 and, in 1949, by Parenago. The latter concluded that there were two possibilities: 1. The period is very long, perhaps about 3,000 years, because nearly all reliable visual observations place the companion near 130° with a separation of 0.9 second. This would, by Kepler's third law, give a total mass of both components of the order of 0.01 solar mass — a value that is inconsistent with our knowledge of the masses of other red supergiants. 2. The period may be only 14 years, the orbit being very eccentric and the inclination close to 90°. In this case the companion would be observed most of the time near apastron, that is, when farthest from the primary star. But only some of the "missing" dates would result from close approaches between companion and primary, while others would still be the result of the companion's faintness.

Parenago made use of the published visual measurements up to 1946. His orbit, however, depends heavily upon an isolated observation by Aitken in 1926, when he gave for the position angle 189° and for the separation 0.31 second. In his famous double star catalogue, Aitken did not reproduce this observation, describing it as "uncertain."

Even so, Parenago's orbit has much to commend it. Van Biesbroeck, who has observed Mira systematically during the past 30 years, remarks in his latest list of measurements: "Parenago's interpretation of the measures seems correct, but his orbit requiring 0″.20 for 1943.31, while the measured distance is 0″.80, will need revision."[3]

One thing is, however, certain. With the 14-year period and a semimajor axis of 0.50 second, the total mass of the system becomes about 50 times that of the sun, with a possible uncertainty of the order of 70 per cent. Since the companion, with its visual apparent magnitude of 10 and a parallax of 0.02 second, would have an absolute magnitude of +7, it must definitely be subluminous.

The mass of this blue companion is probably small, leaving for the red supergiant a mass between 10 and 80 times that of the sun. Parenago believes that the smaller of these values is more nearly correct. At any rate, his orbit gives reasonable masses for the system.

We now come to what is perhaps the most intriguing result of all these investigations. Parenago's orbit requires the companion to pass through periastron (nearest to the primary star) in 1913, 1927, 1941, and 1955. These are almost exactly the epochs of minimum brightness of the companion, according to Fig. 6. Joy, without committing himself with regard to Parenago's orbit, nevertheless remarks, "The explanation of such a coincidence is difficult unless, as seen from the earth, absorbing matter between or surrounding the stars cuts down the light of the companion when it is near periastron."

We are again led, by a new procedure, to the viewpoint that cool supergiant stars may be surrounded by vast masses of gas and of clouds, the latter condensing at times out of the former and then again evaporating into the gaseous state. At apastron, where presumably the absorption by the clouds is small, the distance of the *B* star from the *M* primary is nearly 40 astronomical units; at periastron, the distance may be only five or 10. Since the radius of the supergiant primary is itself about one astronomical unit, it would not be too surprising to find that observable obscuration may take place at five or 10 astronomical units.

Thus we picture Mira as a double star, in which light variations of the enormous red primary occur partly from its expansion and contraction, but mostly from its vast atmosphere in which an obscuring veil in turn forms and dissipates. The small, blue companion exhibits changes in brightness in a 14-year period, seemingly because its orbit is eccentric and it passes into the vast obscuring atmosphere of the primary once during each revolution.

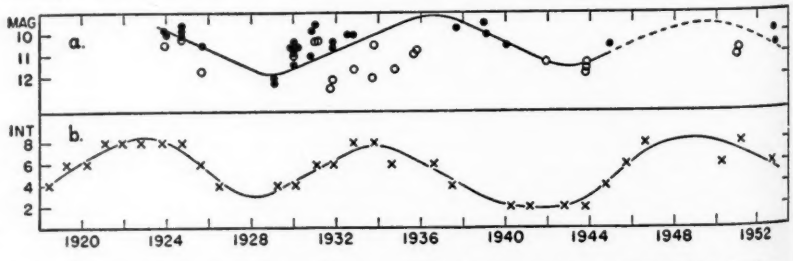


Fig. 6. Compare magnitude estimates of Mira's companion (above) with Joy's intensity estimates of spectra. "Astrophysical Journal" diagram.

3. *Publications* of Yerkes Observatory, VIII, Part VI, 1954, page 34.

(However, P. Couteau, who has summarized the measurements of the companion up to 1952 in *Journal des Observateurs*, *36*, 46, 1953, concludes that the period is much longer than Parenago's 14 years.—ED.)

NEWS NOTES

By Dorrit Hoffleit

AGE OF THE UNIVERSE

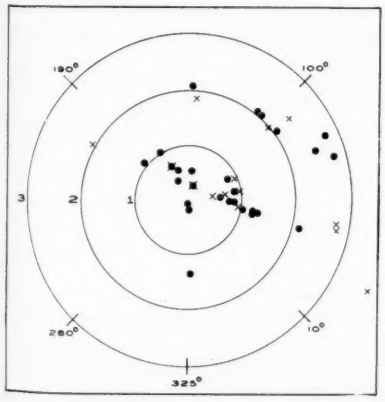
Dr. H. P. Robertson, a mathematical physicist at the California Institute of Technology, reported to the American Philosophical Society recently on the bearing of the revised intergalactic scale of distances on previous discrepancies between geological and cosmological determinations of the age of the universe.

While further data are needed, these two methods appear to be in better agreement than before, even though the important question of the finiteness or infiniteness of the universe cannot be answered. Depending upon just what assumptions are made, particularly with respect to relativity factors and the curvature of space, the time-scale of the universe can be set somewhere between 3¼ and seven billion years. The earth itself is known from geological evidence to be more than three billion years old.

CLUSTERS CONFIRM SPIRAL ARMS

In the April issue of the *Zeitschrift fuer Astrophysik* W. Becker, of Basel University Observatory, and J. Stock, of the Warner and Swasey Observatory, report on their three-color photometric observations of 791 stars in 11 open star clusters. In addition to their own photometry, done at the Hamburg Observatory, they include results for three clusters on which comparable observations were made elsewhere. On the basis of their color measurements, the authors can determine the distances of the clusters, allowing for the effects of interstellar absorption.

It is well known that such clusters lie along the spiral arms of the galaxy. A polar diagram in which the distances from the sun are plotted against galactic latitude immediately shows that the 14 clusters confirm the positions and orientations of the spiral arms first discovered by Morgan, Sharpless, and Osterbrock at Yerkes Observatory (*Sky and Telescope,* April, 1952). Three of the clusters belong to the distant spiral arm whose nearest point is at about 2,000 parsecs in galactic longitude 100°. Eleven clusters are on the spiral arm to which our sun belongs. Extending the earlier Yerkes results, based on early-type stars in emission regions, that revealed a segment of this arm some 3,000 parsecs in length, the new results from clusters indicate a stretch of about 5,000 parsecs.



The circles in this diagram represent distances from the sun in the galactic plane, of 1,000, 2,000, and 3,000 parsecs, respectively. The crosses are for star clusters studied by Becker and Stock; the dots are for objects investigated at Yerkes Observatory.

PRACTICAL SOLAR FURNACE

America's largest solar furnace, designed by Dr. Willi M. Conn and originally used at Rockhurst College, has been put to practical use by Convair's San Diego division. Basically, the furnace is a 120-inch diameter polished aluminum parabolic reflector on an equatorial mounting. At the focus of the mirror, 34 inches from its center, a 5/16-inch image of the sun is formed, and its heat is great enough, according to *Science Digest,* to melt a steel bolt in a matter of seconds. When sky conditions are optimum, the temperature is 8,500° Fahrenheit; an oxyacetylene torch produces only 5,800°. Metal and ceramic samples are tested by Convair by clamping them at the focus of the telescope.

A PHOTOMETRIC CATALOGUE OF DOUBLE STARS

Accurately measured magnitude differences between the components of double stars are becoming increasingly important data for the astrophysicist. In *A General Catalogue of Differences in Magnitude of Double Stars,* published at the Uppsala Observatory, Sweden, Ake Wallenquist has reduced the observations from the many available sources to the same photometric system. His catalogue contains for each of some 1,300 pairs the position for the year 2000, the magnitude of the primary component, the magnitude difference between the two components, and their apparent separation in seconds of arc. Nearly all the doubles included are in the northern sky.

Accompanying the catalogue is a valuable historical account of photometric work on double stars, starting with the pioneer investigations by E. C. Pickering in 1879.

SIX COMETS AND TWO NOVAE

A 10th-magnitude comet (1954d) was picked up in Bootes on June 26th, by L. Kresak at the Skalnate Pleso Observatory in Czechoslovakia, and independently on June 29th by L. C. Peltier, Delphos, Ohio. Preliminary orbit computations give August 30th as the date of perihelion passage, and show that the orbit is practically perpendicular to the plane of the ecliptic. Comet Kresak-Peltier therefore moved rapidly westward and southward during July and August, becoming unfavorably placed in the sky for northern observers.

Another comet, of the 9th magnitude, was discovered in Camelopardalis on July 28th by Miss M. Vozarova, of the Skalnate Pleso Observatory. According to G. Van Biesbroeck's observation of July 30th, it is a centrally condensed, diffuse object, with a short tail. As this report goes to press, no orbit or ephemeris is available.

With the 48-inch Schmidt telescope at Palomar Observatory, R. G. Harrington found a 19th-magnitude comet on June 24th, in Corona Borealis. Despite its extreme faintness, the comet showed a short tail. It passed through perihelion in January.

Three of the periodic comets expected

(Continued on page 400)

IN THE CURRENT JOURNALS

COSMOGRAPHY: AN APPROACH TO ORIENTATION, by Harlow Shapley, **American Scientist,** July, 1954. "There is so much known about the isolation of the Sun in space, the constancy of its radiation, the stability of the earth's orbit, and the long-term stability of ocean depths and continental locations, that we are confident of the comfortable future existence of the sun-fed earth for untold millenia. If man is to disappear during the next geological era it will be through his own folly and inherent weaknesses rather than through the non-cooperation of the heavenly bodies."

THE SUPERGALAXY, by Gérard de Vaucouleurs, **Scientific American,** July, 1954. ". . . there is no mistaking the outlying position of our galaxy in the supergalaxy. This time there is no danger of falling victim to the old illusion [the geocentric point of view]. In fact the Milky Way is so close to the edge of the system that very few nebulae beyond our nearest neighbors appear in the southern hemisphere of the sky."

PROBING THE ATMOSPHERES OF GIANT STARS, by Andrew McKellar, **Journal,** Royal Astronomical Society of Canada, May-June, 1954. ". . . the giant atmosphere . . . can be described as a very extensive atmosphere, with a density gradient much steeper at its base than farther out. The lower part may be like a 'sea of prominences' to account for the 'turbulent velocity' indicated by the intensities of the spectral lines, while the outer chromosphere may contain at any time, one or more large moving masses of gas, possibly the result of a prominence-like activity originating in the lower chromosphere."

AMERICAN ASTRONOMERS REPORT

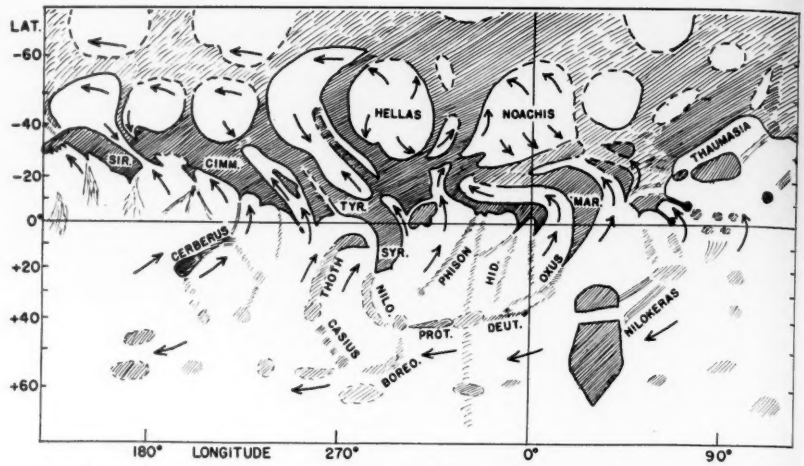
Here are highlights of some papers presented at the 91st meeting of the American Astronomical Society at Ann Arbor, Mich., in June. Complete abstracts will appear in the Astronomical Journal.

Interpretation of Martian Features

The dark markings on the planet Mars are not vegetation, as has often been conjectured, but appear to be drifts of volcanic ash, according to Dr. D. B. McLaughlin, of the University of Michigan. He points out that the major dark areas on the planet are in general very elongated, in directions corresponding to those of the terrestrial trade winds.

This strongly suggests that the dark markings are wind-blown drifts of dust or sand, which trend in the direction of the prevailing winds. The winds of the southern hemisphere summer should be the strongest of the Martian year, and hence the pattern they form would not be erased by the weaker winds of other seasons. The wind-spread material seems to be volcanic dust, originating from active volcanoes at the tips of fan-shaped markings.

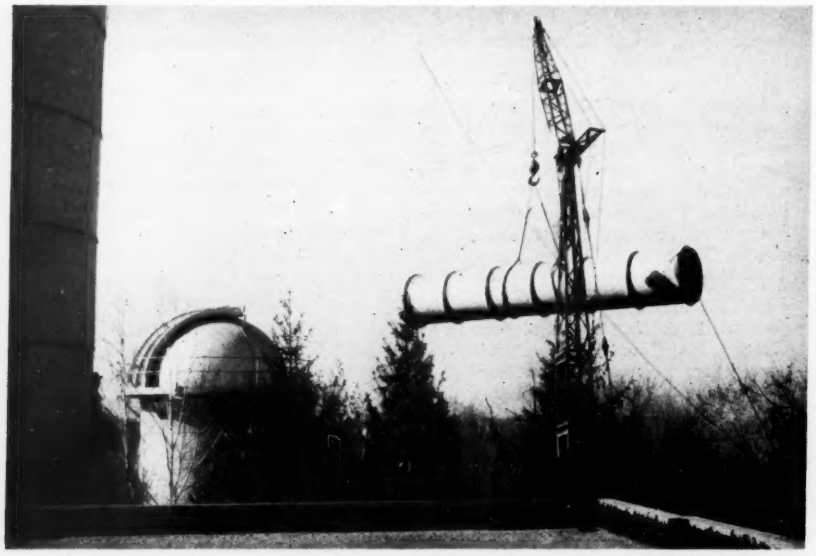
Dr. McLaughlin said: "The green color is an inevitable result of the chemical composition of volcanic ash on the one hand and of the Martian atmosphere on the other. Basaltic and andesitic ash contain high percentages of ferromagnesian silicates. On earth, with abundant oxygen, the weathering of these minerals makes soils that are red, yellow, and brown, due to iron oxide and hydroxide. On Mars, where oxygen is lacking, the carbon dioxide and scant moisture react with the ferromagnesian minerals to form the secondary minerals known as chlorite and epidote. This reaction occurs underground on earth, but at the surface of Mars. Both epidote and chlorite are strongly green in color."



On this sketch map of Mars, the arrows indicate the expected atmospheric circulation during the southern summer. Names of the following Martian features have been abbreviated — Maria: Sirenum, Cimmerium, Tyrrhenum, Syrtis Major, Margaritifer Sinus; canals: Boreosyrtis, Deuteronilus, Hiddekel, Protonilus, Nilosyrtis. Drawing by D. B. McLaughlin.

Seasonal variations in the dark markings might be due to a partial drifting over by the reddish desert dust as the wind pattern changes. While some canals are presumably ash drifts, many can not be so explained, and are perhaps volcanic rifts.

If Dr. McLaughlin's views are accepted, the violent vulcanism on Mars might imply that the planet's present condition is like the earth's some three billion years ago, in early Pre-Cambrian times.



One of the two large sections of the new vacuum solar spectrograph of the McMath-Hulbert Observatory is shown during its installation at Lake Angelus, Mich. The tube is made of rolled and welded plate, ¼-inch thick.

New Solar Spectrograph

A spectrograph of 50 feet focal length, designed to give the high resolving power and great linear dispersion needed to study the profiles of lines in the solar spectrum, is now practically completed at the McMath-Hulbert Observatory of the University of Michigan.

The advantages of long focal length are often vitiated by bad seeing within a spectrograph itself. In the new McMath-Hulbert instrument, described by Drs. R. R. McMath, O. C. Mohler, and A. K. Pierce, this problem is solved by placing the grating and mirrors inside an evacuated steel tube, 52 feet long and four feet in diameter.

Sunlight is first collected by the 50-foot focal length, off-axis mirror system of the McGregor solar tower, which forms an image of the sun at the first slit of a predisperser. The light enters the vacuum tank through a quartz field lens, which acts as the window of the tube. Then it passes through the slit and the length of the tube to a 12-inch spherical collimating mirror, which returns it to the grating, located a few feet inside the head of the tube. The dispersed beam is focused on the second slit by another 12-inch mirror. After passing through a quartz window, the light is received by a photomultiplier.

It is intended to use a Babcock grat-

At the left, the newly elected president of the American Astronomical Society, Dr. D. H. Menzel, confers with the outgoing president, Dr. R. R. McMath, center, and Dr. L. Goldberg. University of Michigan photographs.

Seen at the Ann Arbor meeting were, left to right, Dr. B. Donn (Wayne University), K. G. Henize (University of Michigan), Dr. J. L. Greenstein (Mount Wilson and Palomar), and Dr. M. Savedoff (University of Rochester).

ing in the fifth order, which will give a dispersion of 6.92 millimeters per angstrom in the green region of the spectrum. This enormous dispersion will make possible very accurate determinations of the intensity profiles of solar absorption lines. As the profile of a line is recorded photoelectrically, another photocell will monitor the light entering the spectrograph, so that fluctuations in sky transparency can be allowed for, thus further improving the accuracy of the profiles.

Radio Observations of Diffuse Nebulae

Hitherto most observations of radio discrete sources (radio stars) have been at wave lengths in the meter range. Recently, surveys at 9.4 centimeters have been carried out with the 50-foot paraboloidal antenna of the Naval Research Laboratory, by F. T. Haddock, C. H. Mayer, and R. M. Sloanaker.

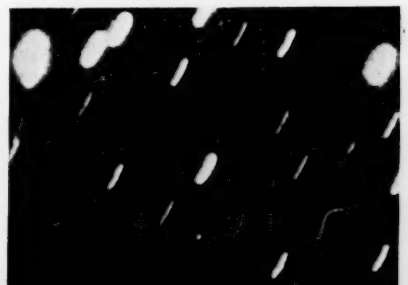
Radio emission from the Orion nebula was detected, indicating a diameter of one quarter of a degree. Since earlier observations at 1.4 meters failed to reveal the nebula, the radio intensity must increase with decreasing wave length — contrary to all previously studied discrete sources. The radio emission from the Orion nebula hence appears to be thermal noise, with an intensity corresponding to a black-body temperature of 100° K. This conclusion is supported by measurements at 21 centimeters, also at the Naval Research Laboratory, by J. P. Hagen, E. F. McClain, and Mrs. N. Hepburn.

Three other diffuse nebulae were detected in 9.4-cm. radiation: M20, the Trifid; M8, the Lagoon; and M17, the Omega. In addition, a second survey at the same wave length revealed emission from 11 bright ionized hydrogen regions, of which eight had been previously undetected by radio techniques.

Five Years of Minor Planet Observations

A leading problem today in asteroid astronomy is the recovery of objects discovered years ago and later lost. Since 1949 Dr. Frank K. Edmondson and his associates at the Goethe Link Observatory, University of Indiana, have searched for these objects with a 10-inch Cooke triplet. The field of the telescope is 50 square degrees.

During 1,786 hours of observing time 1,972 photographs have been taken, on which 189 asteroids were located that either had been lost or were critically in need of observation. In addition, 560 other numbered asteroids were observed; and 886 unidentified minor planets were found, most of which are presumably new. In the course of the work, over 2,600 determinations of position have been made, usually from a pair of plates.



The round image in the center is the minor planet (1322) Coppernicus. During the 45-minute exposure, the Link Observatory's 10-inch telescope was guided to compensate for the asteroid's motion, and hence the star images are trails. The photograph was taken July 9, 1953, by Frank K. Edmondson.

During the exposures the telescope is shifted to allow for the motion of the asteroid sought; thus the minor planet images are points, or nearly so, and the stars form short trails. This method aids the detection of very faint asteroids, and accounts for the large number of unidentified objects, which are nearly all fainter than 16th magnitude. As many as 20 asteroids have been found on a single pair of plates; the comparison is made by means of a blink microscope.

Thirty-one persons, mostly graduate and undergraduate students, have done the work at the telescope, and 15 have worked on measuring and computing. The program was supported by the Office of Naval Research until June, 1952, and has since been sponsored by the Office of Ordnance Research, U. S. Army.

Maintenance of the Zodiacal Light

As a consequence of the Poynting-Robertson effect, the pressure of sunlight causes any small particle circling the sun to suffer a drag, and it will gradually spiral inward until it falls into the sun. This is happening to the swarm of interplanetary particles that produce the zodiacal light, so that this swarm must be continually replenished for the zodiacal light still to be visible.

Dr. Fred L. Whipple, Harvard Observatory, has made calculations which show that meteoritic debris from comets is an adequate source of the needed material. He estimates the original rate of supply as 30 tons per second. This amount is depleted, however, by collisional destruction, by planetary perturbations, and by interaction with the interstellar medium through which the solar system is moving. Nevertheless, what is left after these losses is enough to maintain the zodiacal light.

North of St. Paul, crowds enjoyed an unobstructed view from the old University of Minnesota airport. St. Paul Dispatch and Pioneer Press photograph.

Eclipse Reports at Madison

SOME 75 individuals representing hundreds of observers registered their names and eclipse observing locations at the Madison Astronomical League convention. At the session for eclipse reports on Sunday evening, July 4th, a score of informal talks were given by individuals selected by chairman Paul W. Stevens; he called on them in order of their observing longitudes, from west to east.

The following accounts are abstracted chiefly from a tape recording made at the meeting, and may be considered representative of the experiences of the many amateur astronomers who were in the path of totality at eclipse time.

The first speaker was Dr. Edward M. Brooks, of Overland, Mo., who reviewed the meteorological situation that led up to clear weather at the western end of the shadow path. As he drove to Madison after the eclipse was over, Dr. Brooks stopped about 25 miles south of St. Paul near the Mississippi River, at a place where the road crossed the line predicted as marking the edge of totality. He interviewed a number of farmers up and down the road, asking what they had seen. About 6/10 of a mile north of where the line crossed the road the eclipse was seen total, and about 3/10 of a mile south it was reported partial. There were no farmhouses where people had observed the eclipse between these two points.

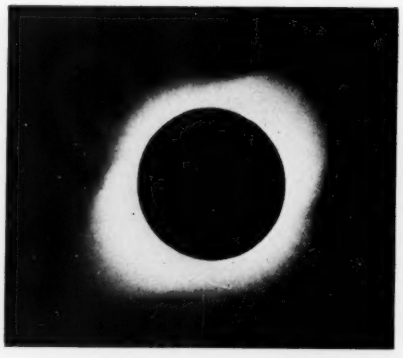
Carl P. Richards, of Salem, Ore., James H. Karle, Portland, Ore., and Norman L. Stauffer, Oswego, Ore., were at Minneapolis. They took Kodachrome movies with a 75-mm. f/2.9 telephoto lens, and color stills with a 135-mm. f/3.5 lens. During totality they took 24 feet of film and 23 stills. Four prominences were noted through binoculars, and the red strip of the chromosphere was seen, persisting for a few seconds after totality. The shadow in the sky was very prominent — toward the sun it was elliptical in shape but flattened at the upper edge. It was a deep velvet black, blacker below the sun, and did not appear to extend closer to the horizon than 2½ or three degrees.

E. M. Brewer, Dallas, Tex., and a group of 14 other Texans were at an airport in St. Paul, and they all attended most of the sessions at the convention.

Joseph A. Anderer, Chicago, was in the Northwest Airlines plane that flew to 20,000 feet (see the August issue, page 334). He noted that the diamond ring at third contact was particularly striking, and saw the corona still visible for five or 10 seconds afterward.

Mr. and Mrs. A. J. Schoen, Lafayette, Ind., were in a plane about 5,000 feet above Amery, Wis., at totality, making naked-eye and binocular observations.

John R. Lorch, Rock Island, Ill., was with the more than 60 members and friends of the Popular Astronomy Club, of Moline, Ill., who traveled to Cumberland, Wis., about 75 miles northeast of St. Paul. Plans made months in advance, with continued local publicity, resulted in a party so large that they occupied two motor courts and a small hotel.



The solar corona had pronounced equatorial streamers. This photograph by Dr. John R. Winckler, physics department, University of Minnesota, is one frame of a series through an Astro-Leica camera of 40 centimeters focal length, 1/40-second exposure at f/5 on Plus-X.

Selection of the site was made in April by Dr. Harry Nelson, of Augustana College. It was about a mile northeast of Cumberland, 100 feet above a lake and with a horizon toward the sun about six to eight miles distant. The expedition was led by Dr. Carl H. Gamble, of Moline.

Mr. and Mrs. Ted Cohen, Chicago, were at Rice Lake, Wis., on U. S. highway 53. They had a Speed Graphic, two motion-picture cameras, and a telescope. Shadow bands were noted on the highway, running back and forth on the dark asphalt. After totality, someone from Oklahoma stopped when he saw the equipment on the road, then produced a Uneeda biscuit through the holes of which he projected images of the crescent sun.

Dr. H. C. Sehested, Ft. Worth, Tex., and his group observed from a fire tower a few hundred yards from Potato Lake, east of Spooner, Wis., at an elevation of 1,934 feet (bench mark) plus 72 feet for the tower height. Their horizon was 15 or 20 miles away, and there was no wind to shake the tower. Dan Davis, Jr., Childress, Tex. (whose honorable mention picture is on page 367), continued the report. They did not see any shadow bands as such, but two to four minutes before totality noted a curious flickering of light. Using binoculars he saw only one prominence; three were seen by others. They saw the ground shadow.

Charles A. Federer, Jr., Belmont, Mass., and his family were at Clam Lake, Wis. They had listened to P. W. Kenworthy's 12:05 a.m. EST broadcast from Minneapolis, while camping at Porcupine Mountains state park in Michigan, where many amateurs and some professional astronomers were located. The prediction for Lake Superior points was not encouraging, so the Federers broke camp at about 12:30 and drove west 120 miles, passing under one or two cloud bands into perfectly clear skies. They wore Polaroid red dark-adapting goggles from soon after dawn until totality, which was viewed over Clam Lake's smooth surface — the latter reflected the eclipse through slowly forming surface fog.

Through a 3-inch telescope, the polar spikes of the corona were long and well defined, like the teeth of a comb, and one prominence was seen to be double. Because of the observers' dark adaptation, the eclipse and the surroundings seemed quite bright during totality, and the diamond ring effect dazzlingly brilliant.

Continuing her father's report, Barbara Federer explained that the family was supposed to have a system worked out, moving around smoothly using the telescope and two pairs of binoculars, but the seconds passed too quickly for everyone to have a chance.

T. L. Gibson, Ft. Worth, Tex., with a party of six, was at Copper Falls state park, close to Mellen, Wis. They had several cameras and a 20x telescope set up on the parking lot. About five to 10 seconds before totality, they noticed an eerie flickering of light. Like many other observers, they found time too short to note all the interesting phenomena — they missed the shadow bands, the prominences, and didn't look for stars, but found the eclipse exceedingly beautiful. Some time before totality, as the sun

rose higher, it became brighter rapidly, and they had to double up on the film they were looking through.

Mr. and Mrs. Carl D. Anderson, Sacramento, Calif., saw clouds hiding the sun for 20 minutes after sunrise at Bessemer, Mich., but totality was observed perfectly there.

Armand N. Spitz, Lansdowne, Pa., led a party at the Gogebic County airport, near Ironwood, Mich., with a program designed to be suitable for air or ground operations, sunshine or otherwise. A series of photometer readings of zenith brightness was made; the results are plotted in the diagram on page 367.

About 20 persons were enlisted to observe shadow bands, on the concrete hangar apron and on the hangar walls, almost perpendicular to the sun's rays. The bands were clearly observed for about two minutes before and after totality. Their over-all motion was definitely downward and to the left before totality, the bands in a 10 to 4 o'clock position; after totality they ran from 8 o'clock to 2 o'clock, sweeping upward and to the left. The distance between them was perhaps eight to 10 inches, and their motion was wavering. An occasional wave moved in the opposite direction, over the principal flow.

Between third and fourth contacts, the Spitz party made two flights in the standby plane to see other expeditions as they completed their photographic programs at nearby locations, including Expedition Blackout from New York City.

Mr. Stevens and his wife were on a steamer in Lake Superior, and although the ship was in the path of totality, they did not see the sun at all during the entire eclipse. There were broken clouds overhead and some blue sky. They contented themselves with noting and photographing the changes in color and illumination. Two hours after totality, the sky was virtually clear.

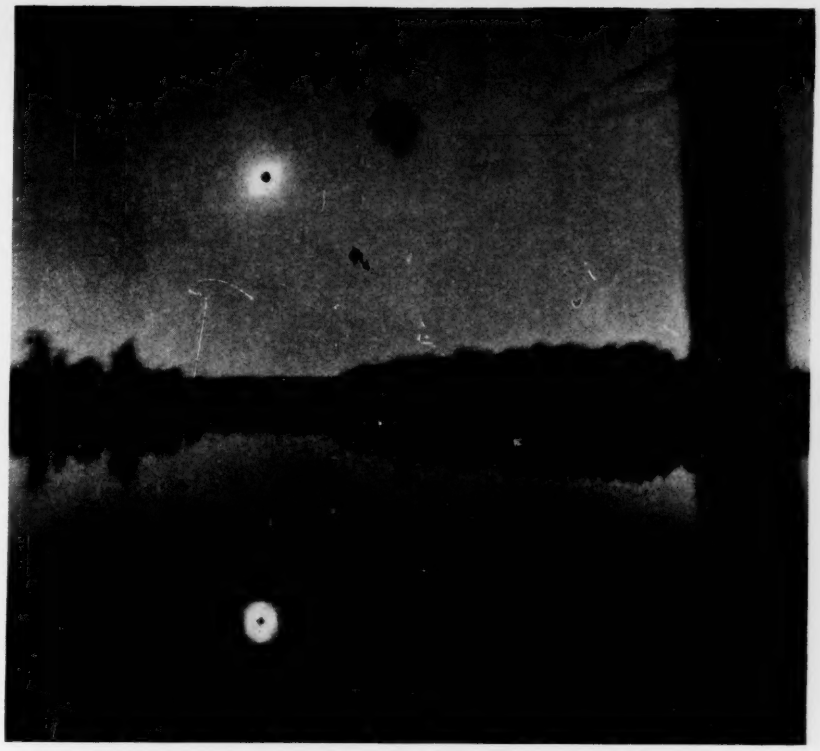
Robert Johnson, Chicago, at the Porcupine Mountains, reported that totality was completely obscured, although the sky to the west seemed to be clear of clouds. There had been an aurora the night before. Several stars were seen during totality: Capella, probably Vega, either Castor or Pollux, and one in the southwestern sky, probably Altair.

Mabel Sterns, Washington, D. C., was at Houghton, Mich., and had arranged for a small plane to take off shortly before eclipse time. In the town at 4:30 it was fairly clear, except for clouds that looked as though they might move off the eastern horizon. At the airport, however, fog rolled in, and the plane couldn't take off. One man had flown up in his own plane from Houston the day before—he spent the entire eclipse time in the weather station. There were planes in the air from other points, which they could hear and contact by radio. The pilot of the plane from Cleveland (see August, page 330) said he could see land at Copper Harbor.

Miss Sterns changed her location after first contact had passed, racing by automobile a few miles. Through the fog, the diamond was seen at second contact, but not the ring. One star, probably Capella, was visible overhead during totality.

Elizabeth Fazekas, Washington, D. C., was at Copper Harbor, Mich., with the Astronomical League bus tour. There were over 50 people on the four-day trip. After dinner Tuesday night they went up the Brockway Mountain drive, where they were to observe, and found many people setting up equipment and hopefully gazing at the sky. On eclipse morning the bus left at 5 o'clock, and on the mountain the sky was practically clear, though there were clouds in the east. It seemed the sun would clear these by totality, but then the wind shifted and fog poured up over the mountain.

The bus travelers were able to see the sun in the late partial phases, and didn't need filters. Just at totality, the sun went



The corona at Clam Lake, Wis., photographed by Tony Federer. He used an f/3.5 lens and Super XX, hand-held for half a second.

Left: Two prints from the same negative, made at Ironwood by Expedition Blackout, with a 6-inch f/6 reflector, 1/25 second on Plus X, to show Baily's beads.

Right: On Brockway Mountain, Keweenaw peninsula, an early arrival was Paul S. Watson, of the Maryland Academy of Sciences, publishers of the "Graphic Time Table of the Heavens."

On Brockway Mountain, overlooking Copper Harbor and Lake Superior toward the rising sun, Jeff McAnally, James Gleim, John Lund, and Robert Rhynsburger, all of Washington, D. C., set up equipment that included a power supply for radio receiver and clock drives. They hoped to catch the flash spectrum and to record stars on an 80-second exposure, but there was dense fog, with only a few holes.

behind a cloud, so they turned and saw the shadow advancing across the sky. Suddenly, for about half of totality, the sun popped out, but it clouded in again toward third contact, and no diamond ring was seen. Miss Fazekas saw no prominences, and she is sure the outer limits of the corona were not visible. Other observers at different places on the mountain saw a great deal more.

T. P. Maher, Portland, Ore., was 10 feet from the shore of Lake Superior in Ft. Wilkins state park, northeast of Copper Harbor, and claims thus to have been the most northerly observer in the United States. Fog banks started to come in long before totality, and he couldn't even see the trees nearby. There was no change in the light intensity until about five minutes before mid-eclipse, and then no sudden darkening at totality.

Roy R. Lee, Boulder, Col., was with a group at Mattice, Ont., using geodetic equipment similar to that of the Air Force expeditions. The Lindblad camera had been constructed by the Milwaukee Astronomical Society. There were two clear days before June 30th, and on the dry runs everything worked perfectly. At 12:30 on eclipse morning there were broken clouds, and at 3 a.m. it was completely cloudy, with a 200-foot ceiling. Nevertheless, the observers ran the cameras and recorded times as planned. Light meter readings were also made. The extreme darkness under the clouds during totality surprised Mr. Lee—if he had not had a spotlight on the desk that held the chronometers he would not have been able to see anything.

In one sense, the eclipse of June 30th is not over, for working up the scientific data will be time consuming and the results of successful professional expeditions will not be known for a long time. Amateurs everywhere now have thousands of photographs and long motion-picture records, which can be enjoyed over and over again. Nevertheless, eclipse enthusiasts are already thinking of the next time: June 20, 1955, an eclipse that provides seven minutes of totality and crosses Manila in the Philippines; October 2, 1959, with the path of totality beginning in southern New England; and July 20, 1963, when the moon's shadow will cross Quebec and Maine.

Above: At the Porcupine Mountains, J. M. Spooner, Gas City, Ind., set up 1,200 pounds of equipment for cinema photography with a 10-inch and a 6-inch. Clouds prevailed.

Left: An automatic electric programming device was designed by Philip Lichtman, Washington, D. C., for this battery of telescopes and cameras, on Brockway Mountain. Totality was faintly visible for several seconds.

Notes on the Eclipse

Eclipse-Meteor Expedition

FROM a 1951 visit to Forest Lake, Minn., some 20 miles north of St. Paul, I knew that the beach there would be a good location for observing the eclipse. Mrs. Wylie and I arrived on June 27th, and by the next evening had a radio receiving set for time signals working well, with the aid of a 50-foot antenna, and other equipment set up.

On Tuesday, Lorin Lloyd, West Branch, Iowa, and Mr. and Mrs. L. A. Dinsmore, Peru, Ind., also arrived at Forest Lake. Mr. Lloyd was clouded out in Canada for the eclipse of 1945. A group of 16 high school girls arrived on Tuesday, but the next morning none of them was up to see the eclipse.

I did not see as much of the corona as we observed from Baker, Ore., on June 8, 1918, and saw no reddish prominences, although they were conspicuous in 1918. Capella was easily detected above and to the left of the sun.

Observing with fogged film and binoculars, I timed the instant of second contact as occurring nearly three seconds earlier than predicted by the *American Ephemeris* tables; such a discrepancy is not unusual, and can be used in correcting the tables for predicting future eclipses. Before dismantling the equipment, I checked my chronometer with National Bureau of Standards time signals.

On the return trip, we detoured from the shortest route to interview observers of the brilliant meteor of June 17, 1954, stopping at such places as Harper's Ferry, Waukon, McGregor, Monticello, Greeley, and Colesburg, in Iowa; Livingston and Platteville, Wis., and Galena, Ill.

C. C. Wylie
State University of Iowa

Zodiacal Light Expedition

THE National Geographic Society expedition consisted of three observers from the Yerkes Observatory, who were joined by Prof. E. A. Fath, of Denver, acting as timekeeper. The aim was to record the brightness of the inner zodiacal light by going to a point where the sun would be some two degrees below the eastern horizon at the moment of totality (see the article in the March, 1954, issue). The site chosen was on a farm four miles north of Haxtun in eastern Colorado. The instrumental equipment consisted of a photoelectric scanner, two wide-angle f/2 cameras of the Henyey-Greenstein type, and two 70-mm. Ektar lenses, f/2.5.

Except for a narrow strip along the horizon, most of the sky was heavily overcast at the time of totality. None of the planned photometric measurements could be carried out. However, in spite of the clouds the shadow could be seen, as shown in the picture. The sky did not by far get as dark as was anticipated and it was evident that the twilight, although reduced by the eclipse, would have still been much too bright to bring out the zodiacal light.

G. Van Biesbroeck,
R. Weitbrecht, and T. Gehrels
Yerkes Observatory

Mattice, Ont.: Twenty-seven persons in all made up the observing group of the Montreal Centre of the Royal Astronomical Society of Canada, including 22 who journeyed by private sleeper car. Among them were 16 members of the centre, Miss Katharine Pearce, librarian at Princeton University, and Percy W. Witherell, Jamaica Plain, Mass.; at Ottawa, four members of the Ottawa Centre boarded the train. The next day L. A. Cotton arrived from Vancouver, B. C. Frank Matthews and Warren Creighton, from Port Arthur, and Mr. and Mrs. F. DeKinder, of Montreal, completed the party.

The equipment included seven telescopes, four moving picture cameras, a radio, barometer, anemometer, chronometer, thermometer, light meter, stop watches, gratings, and the like. Totality was completely clouded out, but a program of temperature, wind velocity, barometric pressure, and light readings, was carried out throughout the eclipse.

Tuesday evening about 200 townsfolk turned out for an impromptu star party, and weather prospects looked bright. But it was overcast at dawn, and before the final meteorological observations were made, about 8 o'clock in the morning, it was raining.

Kapuskasing, Ont., was also a focal point for amateur observers. Edwin V. Greenwood, of Toronto, writes that the local inn was the scene of many eclipse discussions on the night of the 29th, but early risers on the 30th found that a heavy overcast had covered the area. Driving over to Mattice, some 40 miles west on the central line, was a discouraging experience.

Stroemstad, Sweden: As a member of the Royal Astronomical Society - British Astronomical Association expedition, Dr. Karel Hujer, of Chattanooga, Tenn., photographed the inner corona. He used a 2½-inch telescope, with eyepiece and camera attachment arranged by L. Evans, of the Barnard Astronomical Society.

Boulder, Col.: Donald E. Billings writes that R. Cooper, of the High Altitude Observatory staff, had planned to take solar granulation pictures between third and fourth contact, using the Sommers-Bausch telescope at Boulder. A bank of clouds on the eastern horizon blocked the effort, but treated Mr. Cooper to an interesting spectacle. High cirrus clouds far to the east were illuminated in sunrise colors; cutting across them was a dark shadow that apparently marked the path of totality, and that moved as the eclipse progressed.

Kent, England: From Oversland Farm, near Faversham, Brian Chadwick made a series of drawings of the partial eclipse, using a 2.4-inch refractor and 40 power, with excellent observing conditions. His records show that the temperature dropped seven degrees Fahrenheit during the eclipse. The sky darkened to a gray color, but remained blue in the zenith.

ED. NOTE: Eclipse items being held over for our October issue include a photograph from Sweden, the eclipse on television, Expedition Blackout, balloon observations, and a flight from New York.

The Yerkes astronomers in Nebraska, seeking the zodiacal light, were able only to procure this picture of the moon's shadow against the upper atmosphere. It was made on Super XX film with an Ektar lens.

HERE AND THERE WITH AMATEURS

*Members receive *Sky and Telescope* as a privilege of membership. †Member organizations of the Astronomical League.

State	City	Organization	Time	Meeting Place	Communicate With
ARIZONA	Phoenix	*Phoenix Obs. Ass'n	7:30, 1st, 3rd Tue.	Private homes	R. D. Smith, Jr., 6635 N. Central Ave.
	Tucson	*Tucson A.A.	7:30, 1st. Wed.	Steward Obs.	Mrs. Kathryn Burch, 216 Busch Pl.
CALIFORNIA	Fresno	*Central Val. Ast'mers	7:45, 2nd Mon.	Fresno Coll., homes	Elizabeth Dean, 409 Shields (4)
	Kentfield	*Marin Am. Ast.	8:00, 4th Fri.	Marin College	V. S. Yoder, 48 Mercury Ave., Mill Valley
	Long Beach	†*Excelsior Tel. Club	7:30, 3rd Fri.	Art Center	T. R. Cave, Jr., 265 Roswell Ave. (3)
	Los Angeles	L.A.A.S.	7:45, 2nd Tue.	Griffith Obs.	G. Carroll, 7114 Summitrose St., Tujunga
	Oakland	*Eastbay A.S.	8:00, 1st Sat.	Chabot Obs.	Mrs. David Roberts, 551 El Dorado Ave. (11)
	Palo Alto	*Peninsula A.S.	7:30, 1st Fri.	Community Center	H. W. Milner, 350 Tennyson Ave.
	Redlands	*Redlands A.S.	7:30, Tues.	Univ. of Redlands	Miss R. Schweikert, 111 Prospect Dr.
	Sacramento	*Sac. Val. A.S.	8:00, 1st Tue., bi-mon.	Sacramento College	Mrs. E. Champ, 3816 Sacramento Blvd. (17)
	San Diego	Ast. Soc. of S.D.	7:30, 1st Wed.	504 Electric Bldg.	W. T. Skilling, 3140 Sixth Ave.
	San Diego	A.T.M. Ast. Club	7:30, 2nd, 4th Mon.	3121 Hawthorn St.	Al Nelson, 3121 Hawthorn St.
	San Francisco	*S.F. Am. Ast'mers	8:00, 1st Wed.	Randall Junior Mus.	H. A. Wallace, 2925A Jackson St.
	Stockton	*Stockton A.S.	8:00, 2nd Mon.	Stockton College, C-3	Dr. C. P. Custer, 155 E. Sonoma Ave.
COLORADO	Boulder	*Boulder A.S.	7:30, 2nd Wed.	Sommers-Bausch Obs.	Roy R. Lee, 701 Forest Ave.
	Denver	†*Denver A.S.	8:00, 2nd, 4th Fri.	Chamberlin Obs.	John Boatright, 1400 S. Clayton, RA-0375
CONNECTICUT	Middletown	*Centr. Conn. A.A.	8:00, 1st Tue.	Van Vleck Obs.	Walter Fellows, Middle Haddam
	New Haven	†A.S. of New Haven	8:00, 4th Sat.	320 York St.	Florence Welter, 77 Spring Rd., N'th Haven
	Norwalk	*Perkin-Elmer AA&TM	5:00, 1st, 3rd Wed.	Perkin-Elmer plant	J. Vrabel, Bob White Lane, Wilton
	So. Norwalk	†Fairfield Co. A.S.	8:00, Alt. Fri.	Private homes	Goldie L. Grantham, 58 Bouton St.
	Stamford	Stam. Museum A.A.	8:00, 3rd Fri.	Stamford Museum	R. F. Ives, Post Rd. East, Darien
DIST. COL.	Washington	†*Nat'l. Cap. Ast'mers	8:00, 1st Sat.	Comm. Dept. Audit.	Miss G. Scholz, 166 Mason Hall., Al'dria,Va.
FLORIDA	Daytona Beach	D. B. Stargazers	8:00, Alt. Mon.	105 N. Halifax Ave.	Wm. T. Thomas, 105 N. Halifax
	Jacksonville	†*J.A.A.C.	8:00, 1st, 3rd Mon.	Private homes	E. L. Rowland, Jr., 442 St. James Bldg.
	Key West	†Key West A.C.	8:00, 1st Wed.	Private homes	J. M. Martin, 1605 United St.
	Miami	†*South'n Cross A.S.	7:30, 3rd Mon.	Central School	A. P. Smith, Jr., 426 S.W. 26 Rd.
	Miami Springs	†*Gulfstream A.A.	8:00, 4th Fri.	Boys Club, 2805 SW32Av.	L. G. Pardue, 641 Falcon, 88-5434
	Patrick AFB	*Banana River A.S.	8:00, 2nd Wed.	Civilian Personnel Bldg.	Lt. R. W. Edelen, Box 669, Patrick AFB
	Pensacola	†Pensacola A.A.C.	7:30, 3rd Mon.	Private homes	Frank Dachille, 1781 E. Baars St.
	St. Petersburg	†St. P'burg A.A.C.	7:30, 4th Thu.	Museum Auditorium	Dr. R. E. Angell, 233 5th Ave. N.
GEORGIA	Atlanta	†*Atlanta A.C.	8:00, 3rd Fri.	Agnes Scott College	W. H. Close, 225 Forkner Dr., Decatur
	Columbus	*Columbus A.A.C.	7:30, 1st Fri.	Bradley Mem. Lib.	Marcia Thompson, 1306-16 Ave.
HAWAII	Honolulu	Hawaii A.S.	7:30, 3rd Tue.	McKinley H.S., Cot. 36	C. A. Diggs, 1547 Ala Wai Blvd.
IDAHO	Idaho Falls	*Idaho A.A.	8:00, 1st Sat.	475 J St.	Mrs. O. W. Hendrickson, 475 J St.
ILLINOIS	Chicago	†*Burnham A.S.	4:00, 2nd Sun.	Adler Planetarium	J. A. Anderer, 7929 S. Loomis Blvd. (20)
	Galesburg	†*G'burg Am. Ast'mers	7:30, 1st. Wed.	Knox Obs.	H. L. Horein, 1246 N. Morton Ave.
	Geneva	*Fox Valley A.S.	8:00, 1st Tue.	Geneva City Hall	Joseph Zoda, 420 Fellows St.
	Moline	†*Popular A.C.	7:30, Wed.	Sky Ridge Obs.	Carl H. Gamble, 3201 Coaltown Rd.
	Peoria	Ast. Sec., Acad. Sci.	8:00, 2nd Wed.	Peoria Hts. School	R. P. Van Zandt, 156 N. Eleanor Pl. (5)
INDIANA	Indianapolis	†*Indiana A.S.	2:15, 1st Sun.	Riley Library	W. E. Wilkins, 6124 Dewey Ave. (19), IR-5948
	South Bend	*St. Jos. Valley Ast.	7:30, 1st Thu.	YMCA	Bruce A. Lovell, RR 6, Box 61A
KANSAS	Wichita	†*Wichita A.S.	8:00, 1st Wed.	214 East High Sch.	S. S. Whitehead, 425 N. Lorraine (8), 62-6642
KENTUCKY	Louisville	†L'ville A.S.	8:00, 1st Tue.	Univ. of Louisville	B. F. Kubaugh, 207 Sage Rd. (7)
LOUISIANA	Gretna	Gretna A.S.	7:00, Alt. Wed.	Private homes	John A. Gunther, 209 Newton St.
	Lake Charles	†*Lake Charles A.A.C.	7:30, 2nd Thu.	McNeese State Coll.	Norman G. Lore, 532 Alamo St.
	New Orleans	A.S. of N.O.	8:00, Last Wed.	Cunningham Obs.	Dr. J. Adair Lyon, 1210 Broadway
MAINE	Portland	†A.S. of Maine	8:00, 2nd Fri.	Private homes	H. Harris, 27 Victory Ave., S. Portland
MASSACHUSETTS	Cambridge	†*Bond A.C.	8:00, 1st Thu.	Harvard Obs.	R. Smith, 519 Quincy Shore Dr., No. Quincy 71
	Cambridge	†*A.T.M.s of Boston	8:00, 2nd Thu.	Harvard Obs.	John Patterson, 142 Elgin, Newton Center 59
	Cambridge	*M.I.T. A.S.	7:30, Alt. Wed.	Mass. Inst. Tech.	R. L. White, Box 162, 3 Ames St.
	Springfield	†*S'field Stars	8:00, 2nd Wed.	Private homes	J. E. Welch, 107 Low'r B'verly Hills, W. S'field
	Worcester	†*Aldrich A.S.	7:30, 1st, 3rd Tue.	Mus. Natural Hist.	W. C. Lovell, 24 Courtland (2), 3-1559
MICHIGAN	Ann Arbor	†Ann Arbor A.A.A.	7:30, 2nd Mon.	U. of Mich. Obs.	Stewart W. Taylor, 1106 Birk Ave.
	Battle Creek	†B. C. Ast. Club	8:00, 2nd Fri.	Kingman Museum	Mrs. W. V. Eichenlaub, 47 Everett St.
	Detroit	†*Detroit A.S.	2:30, 2nd Sun.	Wayne U., State Hall	E. R. Phelps, Wayne University
	Jackson	Jackson A.S.	7:30, 2nd, 4th Thu.	Public Library	Allen Bell, 1103 Hamlin Pl.
	Kalamazoo	†Kalamazoo A.A.A.	8:00, Sat.	Private homes	Mrs. B. F. Croghan, 216 Burr Oak St. (32)
	Lansing	†*Lansing A.A.	8:00, Fri.	No. 8 Fire Station	Edward H. Carlson, 2111 Grant St. (10)
	Pontiac	†*Pon.-N.W. Det. A.A.	3:00, 3rd Sun.	Cranbrook Inst.	G. Carhart, 40 Hadsell Dr., FE 2-9980
MINNESOTA	Minneapolis	*J.A.C. of M'polis	4:00, 2nd, 4th Wed.	Public Library	C. Shurr, 3917 Vincent Ave. S., WA-3752
	Minneapolis	M'polis A.C.	7:30, 1st Wed.	Public Library	Anna Klint, 2526 Garfield Ave. S. (5)
	St. Paul	†*St. Paul Tel. Club	7:30, 2nd, 4th Wed.	Macalester Coll.	Mrs. R. E. English, 1283 Sargent Ave.
MISSOURI	Fayette	†*Central Mo. A.A.	7:30, 3rd Sat.	Morrison Obs.	R. C. Maag, 816½ S. Mass., Sedalia
	Kansas City	†*A.C. of Kans. City	8:00, 4th Sat.	K. C. Museum	Mrs. Laura Kinsey, 4604 Jefferson (2)
	St. Louis	†*St. Louis A.A.S.	8:00, 3rd or 4th Fri.	Inst. of Tech., St. L. U.	S. O'Byrne, 501 E. Pacific, Webster Groves 19
NEVADA	Reno	A.S. of Nev.	8:00, 4th Wed.	Univ. of Nevada	E. W. Harris, University of Nevada
NEW JERSEY	Caldwell	West Essex A.A.	8:00, 2nd Mon.	Caldwell Mun. Bldg.	Donald C. Smith, 19 Francisco Ave.
	Cranford	†*A.A.S. of Union Co.	8:00, 4th Fri.	Girl Scout House	Mrs. W. N. Lurcott, 220 High St.
	Jersey City	†Revere Boys Club	7:15, Mon., Tue.	Gregory Mem. Obs.	Enos F. Jones, 339 Wayne St.
	Rutherford	A.S. of Rutherford	8:00, 1st Thu.	YMCA	W. B. Savary, 78 W. Pierrepont Ave.
	Teaneck	†Bergen Co. A.S.	8:30, 2nd Wed.	Obs., 107 Cranford Pl.	J. M. Stofan, 332 Herrick
NEW MEXICO	Las Cruces	†*A.S. of L.C.	...., 1st Sat.	Private homes	C. W. Tombaugh, 636 S. Alameda
	Roswell	*Pecos Val. S.&T.C.	7:30, 2nd Fri.	Cha. of Comm.	Dr. R.R. Boyce, Rt. 2, Box 163A
NEW YORK	Brooklyn	†Junior A.C.	8:00, 3rd Fri.	Bklyn Public Library	Jr. A.C., Pub. Lib., Grand Army Plaza (38)
	Buffalo	†*Buffalo A.A.	7:30, 1st Wed.	Mus. of Science	Dr.F.S.Jones,83Briarcliffe,Cheektowaga(25)
	Corning	Corning A.C.	8:00, 1st, 3rd Mon.	Corning Glass Center	W. R. Redmond, 119 E. 2nd St.
	Gloversville	†A.C. of Fulton Co.	...., ...	.....	L. R. Ogden, 60 W. Pine St.
	New York	*A.A.A.	8:00, 1st Wed.	Amer. Mus. Nat. Hist.	G. V. Plachy, Hayden Plan., TR 3-1300
	Rochester	†Ast. Sec., Acad. Sci.	8:00, 1st Fri.	Rochester Museum	Louise Zeitler, 91 Hickory St. (20)
	Schenectady	†*S'tady A.C.	7:30, 3rd Mon.	Nott Terrace H. S.	C. E. Johnson, 102 State St.
	Troy	*Renss. Ap. Soc.	7:30, Alt. Tue.	Sage Lab., R.P.I.	Dr. Robert Fleischer, R.P.I.
	Troy	*Troy A.C.	8:00, 4th Sat.	Private homes	P. Cenni, 2316 6th Ave.
	Utica	†*Utica Am. Ast'mers	7:30, 4th Tue.	Proctor Inst.	John Zimm, 239 Thieme Pl.
	Wantagh	Long Island A.S.	8:00, Sat.	Private homes	A. R. Luechinger, Seaford Ave., 1571
N. CAROLINA	Greensboro	†*Greensboro A.C.	8:00, 2nd Wed.	Woman's Coll., U.N.C.	Mrs. J. Bradshaw, Guilford College, N.C.
	Raleigh	†Astronomical Soc.	...., 1st, 3rd Thu.	N. C. State Coll.	Richard C. Davis, Sch. of Textiles
	Winston-Salem	†*Forsyth A.S.	7:30, Last Fri.	Private homes	Kenneth Shepherd, 1339 W. 4th St.
NORTH DAKOTA	Grand Forks	†*Red River A.C.	8:00, 2nd, 4th Mon.	City Hall	L. G. Peck, 2101 1st Ave. North
OHIO	Akron	*A.C. of Akron	8:00, Last Fri.	St. Peter's Epis. Church	Mrs. R. J. Couts, 878 Kennebec Ave. (5)
	Cincinnati	*Cin. A.A.	8:00, Various days	Cincinnati Obs.	Robert Berkmeier, 2432 Ohio Ave.
	Cincinnati	*Cin. A.S.	8:00, 3rd Wed.	5556 Raceview Ave.	John Dann, 3318 Felicity Dr. (11)
	Cleveland	†Cleveland A.S.	8:00, Fri.	Warner & Swasey Obs.	Mrs. Helen Strohm, Warner & Swasey Obs.
	Columbus	*Columbus A.S.	8:00, 2nd Sat.	McMillin Obs.	Miss R. A. Charlton, 1361 E. 22 Ave. (11)
	Dayton	A.T.M.s of Dayton	Eve., 3rd Sat.	Private homes	F. E. Sutter, RR 7, Box 253A (9)
	Lorain-Elyria	*Black River A.S.	7:30, 1st Wed.	Spang Bldg.	Louis Rick, Box 231, Lorain
	Marietta	Marietta A.S.	Irregular	Cisler Terrace	Miss L. E. Cisler, Cisler Terrace
	Toledo	Toledo Ast. Club	...., 3rd Tue.	Univ. of Toledo Obs.	E. D. Edenburn, 4124 Commonwealth Ave.
	Warren	Mahoning Val. A.S.	8:00, Thu.	Private homes	S. A. Hoynos, 1574 Sheridan, NE, 25034
	Youngstown	*Y'town A.C.	7:30, 1st Fri.	Homestead Pk. Pav'n.	F. W. Hartenstein, 905 Brentwood
OKLAHOMA	Tulsa	†*Tulsa A.S.	7:30, 1st Sat.	Private homes	R. L. Frossard, 4218 E. 25th Ave.
OREGON	Portland	†*Portland A.S.	8:00, Tue.	.....	H. J. Carruthers, 427 S.E. 61 Ave.
	Portland	†A.T.M. & Observers	8:00, 2nd Tue.	Private homes	Miss M. Edgar, 1626 S.E. Neholem (2)

☆ ☆ SKY AND TEACHER ☆ ☆

Sponsored by the

Teachers' Committee of the American Astronomical Society

Books for Amateurs

NO MATTER how much or how little an amateur knows about his subject, he constantly searches for books that will tell him more. If a newcomer to this field surveys the astronomy section of his public library, he will no doubt be confronted with a bewildering assortment of titles, some good for his purpose, some unsuited, and some that are considerably outdated in method of presentation or subject matter.

To attempt to aid in the selection of books in astronomy, some recommended titles for children and for beginners are listed below, with brief comments. Prices are included, but they are subject to change.

BOOKS ESPECIALLY FOR CHILDREN

Starcraft, William H. Barton, Jr., and Joseph M. Joseph. Whittlesey House, New York, 1946, $2.75. Primarily for high-school age, but suitable for all beginners, it features instructions for making things and for specific projects.

The Heavens Are Telling, Urana Clarke. Acorn House, New York, 1951, $2.95. Good for everyone who wants to learn about the stars, this book has wide scope. It approaches the subject through the questions that are most often asked by the beginner.

Worlds in the Sky, Carroll Lane Fenton and Mildred Adams Fenton. John Day Co., New York, 1950, $2.50. This is a 96-page book about astronomy for 9- to 12-year-olds. It has large type and many illustrations, and a few minor inaccuracies.

Fun with Astronomy, Mae and Ira Freeman. Random House, New York, 1953, $1.50. The authors write for children among the 8- to 10-year-olds. They point out many simple experiments for those who want to do as well as to see.

Galileo — First Observer of Marvellous Things, Elma E. Levinger. Julian Messner, New York, 1952, $2.75. Here we are told in a simple direct manner the favorite stories about Galileo that make welcome reading.

Looking at the Stars, Carlos S. Mundt. Wm. C. Brown Co., Dubuque, Iowa, 1952, $1.50. This book for the beginning stargazer has fold-over star charts and a special binding for easy out-of-door reference.

Primer for Star-Gazers, Henry M. Neely. Harper and Bros., New York, 1946, $5.00. The author uses a novel approach in showing how to find the constellations by direction, height, and angle.

The Stars for Sam, W. Maxwell Reed. Harcourt Brace and Co., New York, 1931, $4.00. This is a well-known standard book for young people.

Patterns in the Sky, W. Maxwell Reed. Wm. Morrow and Co., New York, 1951, $2.50. The author weaves the magic of the romance of the constellations using star charts and mythology.

Star Stories, Gertrude C. Warner. The Pilgrim Press, Boston, 1947, $1.25. Provides a challenge and provokes the interest of the child in his surroundings. It tells facts about the stars but includes no mythology.

BOOKS FOR BEGINNERS

Pictorial Astronomy, Dinsmore Alter and Clarence H. Cleminshaw. Thomas Y. Crowell Co., New York, 1952, $4.50. Astronomical information is presented descriptively and simply. The book is an excellent source that is frequently used as a high school text or for a brief college course.

Splendors of the Sky, Charles and Helen Federer. Sky Publishing Corporation, Cambridge, Mass., 1954, 75c. A simple booklet of large format, composed mostly of pictures accompanied by brief descriptions.

Introducing the Universe, James C. Hickey. Dodd, Mead and Co., New York, 1951, $3.50. A brief, interesting introduction to astronomy.

Observing the Heavens, Peter Hood. Oxford University Press, New York, 1951, $1.75. A good beginning book covering the whole field briefly and answering the questions the beginner often asks.

The Stars in Our Heaven, Peter Lum. Pantheon Books, New York, 1948, $3.75. Tells fascinating myths and legends of many peoples and races and describes the appearance of the sky at different latitudes.

Sun, Moon, and Planets, Roy K. Marshall. Henry Holt and Co., New York, 1952, $2.50. A book on the solar system, easy to read for all ages.

Insight Into Astronomy, Leo Mattersdorf. Lantern Press, New York, and Sky Publishing Corporation, Cambridge, Mass., 1952, $3.50. Clear and readable, aimed at the uninitiated in an attempt to instill a desire to learn more.

The Stars — A New Way To See Them, H. A. Rey. Houghton, Mifflin Co., Boston, 1952, $4.00. Sketches and clever artistry point out a new method of finding stars and having fun doing it.

The True Book About the Stars, H. P. Wilkins. Frederick Muller, Ltd., London, 1953, 6s. A general introduction by the well-known English student of the moon.

Stars, Herbert S. Zim and Robert H. Baker. Simon and Schuster, New York, 1951, $1.00 paper cover; $1.50 cloth. In pocket-book size, this is a general introduction, profusely illustrated in color. It is one of the Golden Nature Guide series.

Undoubtedly, other suitable good books have not been mentioned, and in this first list we have not included those specifically oriented for either general or specialized observing. Later lists to be published in this department will include books for intermediate and advanced amateurs, also those of more restricted subject matter.

GRACE C. SCHOLZ, chairman
Astronomical League Book Service
166 Mason Hall Apts.
Alexandria, Va.

HERE AND THERE WITH AMATEURS (*continued*)

State	*City*	*Organization*	*Time*	*Meeting Place*	*Communicate With*
PENNSYLVANIA	Beaver	†*Beaver Co. A.A.A.	8:00, 4th Tue.	Com'y Bldg., Tamaqui	Mrs. R. T. LuCaric, Box 463, Baden
	Millvale	A.A.A. Shaler T'ship	8:00, 3rd Fri.	Cherry City Fire House	Cliff Raible, Rebecca Sq. (9)
	Philadelphia	†A.A. of F.I.	8:00, 3rd Fri.	Franklin Institute	Edwin F. Bailey, LO 4-3600
	Philadelphia	†*Rittenhouse A.S.	8:00, 2nd Fri.	Franklin Institute	John Streeter, LO 4-3600
	Pittsburgh	†*A.A.A. of P'burgh	8:00, 2nd Fri.	Buhl Planetarium	Mary Burcik, 315 Moore Ave. (10)
	Pottstown	†Pottstown A.A.C.	7:30, Fri.	Public Library	W. E. Schultz, Public Library
RHODE ISLAND	Providence	Skyscrapers, Inc.	8:00, Mon. or Wed.	Ladd Observatory	Ladd Obs., Brown U., Jackson 1-5680
TENNESSEE	Chattanooga	†*Barnard A.S.	8:00, 3rd Fri.	Jones Observatory	A. H. Jones, 411 W. 21st St., 5-1646
	Memphis	†Memphis A.S.	8:00, 1st Fri.	Memphis Museum	J. M. Buhler, 3796 Central Ave.
	Nashville	*Barnard A.S.	7:30, 2nd Thu.	Dyer Observatory	Miss J. Saffer, 446 Humphrey St. (10)
TEXAS	Austin	*Forty Acres A.C.	7:30, 2nd Tue.	U.of Tex.,Physics Bldg.	Forty Acres A.C., Box 7994, Univ. Sta.
	Dallas	†Texas A.S.	8:00, 4th Mon.	Various auditoriums	E. M. Brewer, 5218 Morningside, U-6-3894
	Ft. Worth	†*Ft. Worth A.S.	8:00, 4th Fri.	Texas Christian U.	James M. McMillen, 604 Tierney Rd. (3)
	Port Arthur	†*Port Arthur A.C.	7:30, 2nd Thu.	5228 Fifth St.	P. T. Newton, 5213 Fifth St., 2-4807
UTAH	Salt Lake City	†*A.S. of Utah	8:00, 2nd Fri.	City and County Bldg.	James W. Geertsen, 1197 Whitlock Ave.
VERMONT	Springfield	†Springfield T.M.s	6:00, 1st Sat.	Stellafane	John W. Lovely, 27 Pearl St., 535-W
VIRGINIA	Harrisonburg	Astral Society	7:30, 3rd Thu.	Vesper Heights Obs.	M. T. Brackbill, Eastern Mennonite College
	Norfolk	†*Norfolk A.S.	8:00, 2nd, 4th Thu.	Museum of Arts	A. Hustead, U.S. Weather Bureau, 21745
	Richmond	†*Richmond A.S.	8:00, 1st Tue.	Builders Exchange	J. S. Stith, 3125 Lamb Ave. (22)
WASHINGTON	Seattle	†*Seattle A.A.S.	8:00, 2nd Fri.	YMCA,5003-12 Ave.N.E.	Louise Crowley, 4727-16 Ave. N.E. (5)
	Spokane	†*A.T.M.s of Spokane	8:00, Last Fri.	Private homes	Mrs. E. Mortensen, W. 1519 Augusta Ave.
	Tacoma	Tacoma A.A.	8:00, 1st Mon.	Coll. of Puget Sd.	Dorothy E. Nicholson, 2816 N. Union Ave
	Yakima	†*Yak. Am. Ast'mers	8:00, 2nd Mon.	Cha. of Comm. Bldg.	Edward J. Newman, 324 W. Yakima Ave.
WISCONSIN	Beloit	†*Beloit A.S.	7:30, 2nd. 4th Wed.	YMCA Bldg.	K. E. Patterson, 318 Public Service Bldg.
	Madison	†Madison A.S.	8:00, 2nd Wed.	Washburn Obs.	Dr. C. M. Huffer, Washburn Obs.
	Milwaukee	†*Milw. A.S.	8:00, 2nd Mon.	Public Museum	E. A. Halbach, 2971 S. 52 St. (15)

Amateur Astronomers

Eclipse Projects in the Twin Cities

POSSESSING the grandstand for nature's greatest show, and located in the "friendly city," the St. Paul Telescope Club adopted as its major project for the year the task of being good hosts to the many visitors who would come to view the eclipse.

The first step was to mail an outline of the plans to planetariums and observatories, and to the astronomy clubs listed in *Sky and Telescope*. Visitors were requested to register, without charge, either by mail or in person at Macalester College, in order that the club could contact them and be of some service. Eighty-five parties responded, representing about 300 persons from all parts of the country and even from the Canal Zone and France.

Early in the year the local airlines were contacted and arrangements were made for plane service to view the eclipse. Although one of the airlines had more applications than it could accommodate, the last plane was filled only late the day before, and everyone who registered in person was able to obtain plane space.

The club selected the Anoka County airport as its official viewing site, where it was easy to handle the more than 1,000 persons who were there. Because even this excellent location could have been too crowded, no invitation was issued to the million people living in the Twin Cities metropolitan area. Everyone at the airport was either a visitor, a club member, or a friend of the club. Chartered busses picked up visitors at their hotels and took them to the site.

On the evening before the eclipse, a special meeting of the club was held, and 250 visitors heard Dr. H. Percy Wilkins, of the British Astronomical Association, give his excellent illustrated lecture on the moon. Dr. Edward M. Brooks, St. Louis University, presented a review of the meteorological conditions that assured the viewers here a splendid eclipse morning. On the preceding Sunday, an outdoor telescope show was staged for one of the national television and radio chains.

Mrs. R. E. English, secretary
St. Paul Telescope Club

FORTY members of the Junior Astronomy Club of Minneapolis participated in observing the eclipse from the old University of Minnesota airport, close to the central line. A main objective of the expedition was to make a complete motion picture record of the phenomenon. This was accomplished with five 16-mm. movie cameras operating with Kodachrome film. After processing and editing are complete, the film will be used for educational purposes.

Several 35-mm. still cameras were used. Excellent color photographs of the corona were obtained with one 35-mm. camera fitted with a 15-inch telephoto lens. Also in action were several photographic telescopes and a solar camera employing a 40-inch Bausch and Lomb telephoto lens.

The advisor of the Junior Astronomy Club of Minneapolis, Maxine Begin, here prepares to snap the eclipse through a 15-inch telephoto lens.

Meteorological observations supplemented the photographic program. Temperature and barometric variations were recorded during the eclipse, along with changes in light intensity (see page 367).

The timing of contacts was done by a special crew equipped with stop watches and time-signal apparatus, using a 3-inch refractor.

Sketches of the inner and outer corona were made by a club artist through an 8-inch rich-field telescope. These will be useful in preparing a detailed painting of the coronal structure.

Craig L. Shurr, president
Junior Astronomy Club of Minneapolis

Northwest Region Meets at Portland

THE SEVENTH annual convention of the Northwest Region of the Astronomical League was held in Portland, Ore., on June 19th and 20th, with the Portland Astronomical Society and the Amateur Telescope Makers and Observers as the host clubs. Societies in Spokane, Seattle, and Tacoma sent delegates for the first time. The Yakima Amateur Astronomers were represented as usual. Sixty members and friends registered for the convention, and 43 attended the banquet Saturday evening.

A number of papers were given during the afternoon, and slides were shown by Howard Thomas, of Spokane, and by Edward J. Newman, of Yakima. Norman Dalke, of Seattle, reported on his society's observatory project. The speaker for the evening was John Holeman, of Richland, Wash. He had recently made a trip to New Zealand where he visited amateur astronomers.

Officers of the Northwest Region for the coming year were elected: Mr. Thomas, chairman; Mr. Dalke, vice-chairman; Dr. Bernard Berenson, Portland, executive secretary; Margaret E. Kobs, Portland, recording secretary; William B. King, Seattle, treasurer; Mr. Newman, national council representative.

Margaret Edgar Kobs
1626 S. E. Nehalem
Portland 2, Ore.

The Northwest regional meeting, June 19-20, 1954. The photograph was taken by Margaret Edgar Kobs.

KEY TO PHOTOGRAPH

Front row: F. Renner, E. Newman, D. McKeraghan, Miss M. Krutsinger, Miss D. Andrus, Mrs. E. Klimas, Mrs. C. Richards, Miss M. Stewart, and T. Maher.

Middle section: N. Dalke, H. Carruthers, J. Liston, F. Moore, J. Knuijt, V. Moore, H. Richards, G. Andrus, C. Richards, J. Holeman, F. Alfano, H. Thomas, R. Dycus, H. McDaneld, E. Klimas, and J. Heilig.

Back row: W. King, H. Kobs, R. Barnes, G. Hohnstein, L. Butler, D. Lang, G. Moffatt, and D. Anderson.

THIS MONTH'S MEETINGS

Chicago, Ill: Burnham Astronomical Society, 3:30 p.m., Adler Planetarium. Sept. 12, eclipse and convention reports.

Dallas, Tex.: Texas Astronomical Society, 8 p.m., Lone Star Gas auditorium. Sept. 27, election of officers.

Geneva, Ill.: Fox Valley Astronomical Society, 8 p.m., City Hall. Sept. 28, Clarence R. Smith, "Photographing the Eclipse of the Sun."

NORTH CENTRAL OFFICERS

New officers of the North Central Region of the Astronomical League are Herbert Cornell, Milwaukee, Wis., chairman; Mrs. Ralph N. Buckstaff, Oshkosh, Wis., vice-chairman; John Schieck, Moline, Ill., continuing as treasurer.

NOX EX DIE — CHILDREN ADMITTED FREE

ABOVE is the title of an item in the *Official Weekly Road Bulletin*, No. 7, for June 4, 1954, issued by the Ontario Department of Highways. Here are some excerpts from the article:

In conjunction with the Department of Travel and Publicity and the Department of Planning and Development, the Department of Highways has arranged, for this year only because of the great expense involved, a spectacle to which the adjectives "stupendous" and "colossal" can be applied without hyperbole. This event, which is tentatively scheduled to take place on June 30th, will be The Total Eclipse of the Sun. Strong pressure is presently being put upon the Dominion Weather Bureau for its co-operation, and when it is assured, arrangements to hold the eclipse on the date mentioned will go forward as planned. The exhibition is for one day only. Rainchecks will positively not be issued, nor will the show be taken on the road however great its success. . . .

One heavenly body is said to be eclipsed by another when the second body passes between the observer and the first body so as to obscure part or all of it. The preceding sentence was lifted verbatim from the Encyclopedia Britannica. . . . Let's see whether we can translate the Britannica into modern Canadianese. Suppose the sun represents the five ball lying directly in front of the side pocket and the earth, the cue ball. The moon comes to rest between the two — it will seem black at the time of total eclipse — and there you are behind the eight ball with a bank shot off infinity your only chance. If, however, your youth was not mis-spent and the foregoing therefore lost upon you, let's try calling the sun, the cup, and the earth, your ball. You will then readily understand the nature of an eclipse when it is said that you are stymied by the moon. Finally, for those with no sporting blood whatever, imagine that you have seat 18, centre aisle, row 6. In that position consider yourself the earth instead of just the salt of it. The stage now becomes the sun. Then into seat 18, centre aisle, row 5 obtrudes a large female body — the moon — wearing one of those huge monstrosities which the Sex refer to, with coy sadism, as hats. Brother, that is an eclipse. If by now this phenomenon is not completely clear, we suggest you consult the Encyclopedia Britannica.

MADISON CONVENTION

By Joseph A. Anderer

Burnham Astronomical Society

ON THURSDAY evening, July 1st, amateur astronomers began to stream into Madison and the beautiful University of Wisconsin campus, to attend the 1954 convention of the Astronomical League. Shortly after dusk, Dr. H. Percy Wilkins, visiting English astronomer, pointed out the slenderest imaginable crescent moon, just setting over Lake Mendota, only 40 hours after its eclipse rendezvous with the sun.

Delegates, most of whom had been in the path of totality the previous morning, stopped to contemplate the new moon, and then resumed swapping eclipse stories and greeting old friends.

Activities for the next few days were centered about Babcock Hall, where the main lecture chamber served as the meeting room. The opening gavel was struck on Friday afternoon, and President Rolland R. LaPelle asked for the roll call of societies. Reports by officers and section chairmen revealed that the league is now in its healthiest condition in history. Several new societies have joined during the year, and the various activity groups, such as instruments, observing, and juniors, reported a high level of action.

On Friday evening a special trip was made to Yerkes Observatory, 70 miles away, by bus and automobile. As the weather was poor, the visit was chiefly an inspection tour of such attractions as the world's largest refractor, and the optical shop. Newcomers to Yerkes found the 40-inch larger and more massive than they had expected.

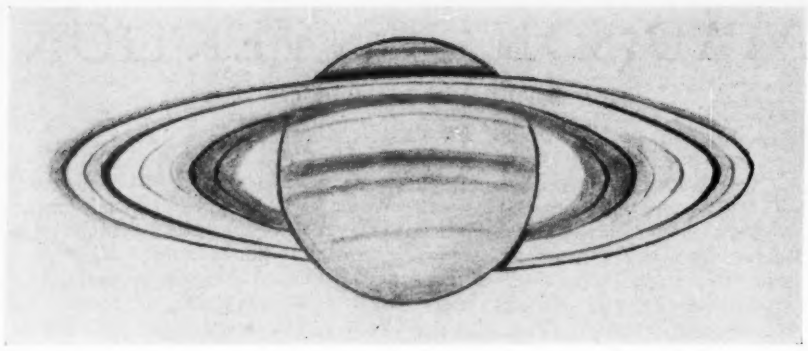
A timely topic for the Saturday opening session was the sun, with James H. Karle, Portland, Ore., presiding. Of great interest was a paper by Thomas A. Cragg, Mount Wilson Observatory, on the present phase of the sunspot cycle. Although we know that the cycle is now near minimum, the actual date of this minimum cannot be determined until the new cycle is well under way. As of June, 1954, four high-latitude sunspot groups of the new cycle had been observed at Mount Wilson.

Mr. Cragg related the following statistics: The average latitude of spots was 10°.7 in the northern hemisphere and 10°.4 in the southern in 1952, while in 1953 these figures were 9°.9 and 8°.6, respectively. So far in 1954, the averages are 3°.5 north and 4°.2 south. New-cycle spots usually first appear when the average latitude of the old cycle reaches about 8°, with actual minimum about eight or nine months later. This would indicate that the minimum is very near, and the present level of activity is below that of some past minima. The low sunspot counts of November, 1953, through February, 1954, may mark the present minimum. On the other hand, we have a long time to go to equal the minima of 1901 and 1913, both of which lasted four years.

An interesting report on German amateur astronomy from 1945 to 1954 was sent by Guenter D. Roth, of Munich, and the Planetensektion der Sternfreunde. We must admire our German colleagues for the manner in which they have carried on in the face of great difficulties.

The election of national officers was held at the business meeting Saturday afternoon. The new president is Mr. Karle; the vice-president is Russell C. Maag, Sedalia, Mo.; secretary, Joseph A. Anderer, Chicago, Ill. Continuing as treasurer is Mrs. Ralph N. Buck-

The Wilkins family is here caught at an informal moment leaving the dining hall at the University of Wisconsin. Dr. Wilkins is at the right, followed by his daughter and wife. Photograph by Tony Federer.



The much-discussed ring D of Saturn can be seen in this drawing by Thomas A. Cragg as a faint shading at the outer edge of the ring system, particularly at the left. He used a 12-inch reflector, powers 168, 200, and 336, on June 5, 1954, at 6:50 UT, when the seeing was 5 to 6 on a scale of 10.

staff, Oshkosh, Wis., while Mrs. Wilma Cherup, Pittsburgh, Pa., was elected to fill a two-year term as executive secretary.

Observing subjects continued to be discussed, including "The Possibility of Search Techniques for Other Satellites of the Earth," by John P. Bagby, of the Burnham Astronomical Society. He pointed out that small moonlets could be circling the earth at surface distances less than 1,000 miles and in periods of less than two hours. At these low altitudes, visibility would be limited to small portions of the earth's surface. At night, when they were in the earth's shadow, such objects could not be seen; in fact, the only hope for viewing them would be when they might pass across the face of the sun or moon, or shortly after sunset against a twilight sky, when they would reflect light from the sun. To detect such elusive objects, Mr. Bagby suggested the use of Schmidt or Maksutov cameras. Serious observing amateurs who develop the proper equipment and techniques might make original discoveries of such satellites, if any exist.

Thomas R. Cave, Jr., president of the Western Amateurs and a member of the Mars Committee, gave a very interesting review of current programs on Mars; he presented slides and described the fascinating details that can be observed at favorable oppositions of the red planet.

Mr. Cragg, who is Saturn recorder for the Association of Lunar and Planetary Observers, told about a very remarkable discovery of a faint outer ring of Saturn. Rather, this should be called a rediscovery or a recovery, since the faint ring was detected in 1907, and was followed until 1909 by French and English observers. When such an assiduous observer as E. E. Barnard was unable to find it with the Yerkes 40-inch, it was given up and soon forgotten. Early in 1952, R. M. Baum, in England, and Mr. Cave and Mr. Cragg independently recovered the ring. Their 1954 drawings show it as a dark body on the south side of the projected ring ellipse, against the bright disk of the planet itself.

At this time, the shadow of the rings on the ball of the planet fell north of the projected ring ellipse. The dark band was computed to lie in a position where there are no belts on the disk of Saturn. On April 22nd, Mr. Cragg had a fine view of Saturn with the Mount Wilson 60-inch reflector which clearly revealed the dusky shading (not a shadow) crossing the ball immediately adjacent to the southern edge of the ring ellipse. This was compared with the shadow of the ball on the ring, and it was obvious that the dusky shading was not the shadow of ring A or B. A photograph taken the same night by Drs. E. Pettit and R. S. Richardson, with the 100-inch reflector, showed the same features as were observed visually at the 60-inch.

On June 5th, with a 12-inch reflector, Mr. Cragg definitely saw ring D off the ball of the planet. This was confirmed independently by another observer with a 6-inch reflector. Ring D is fainter than ring C (the crape ring) by a factor of a little less than 2, so unless the latter can be seen rather easily at the ansae, ring D will probably be invisible. The "new" ring is more conspicuous at low inclinations of the ring system to the line of sight.

At the convention banquet, a gala affair, the Astronomical League award was presented to Armand N. Spitz, the citation reading that he had "developed and perfected a small relatively inexpensive planetarium projector as well as a larger more elaborate model. Being the first commercial source of such instruments in the United States . . . such instruments have rendered possible the effective teaching of astronomy throughout the United States and in foreign countries, and in the armed forces for the teaching of navigation . . . we deem this device to have contributed in a significant way to the development of amateur astronomy in public knowledge and support of astronomy."

Another Astronomical League award was given to Dr. Wilkins, for his lunar work, the citation pointing out: "The

The general convention of the Astron

study of the surface of the moon has been largely relegated to the work of amateur observers . . . recording of this work has been largely in the hands of the B. A. A. lunar section . . . under the direction of H. P. Wilkins . . . he maintained the official large-scale map of the lunar surface whereon has been recorded all of the known detail regarding these features, and the nomenclature officially attached thereto."

As banquet speaker, Dr. Wilkins described amateur astronomy in the British Isles. He noted that, in spite of adverse weather conditions prevalent in Great Britain, much of our knowledge of lunar and planetary details has been gathered by BAA members in the last three quarters of a century.

For the first time at a general league convention, a session was held on lunar observing, under the chairmanship of Mr. Maag. There were two papers on lunar photography, one by Mr. Roth, and the other by Lyle T. Johnson, of La Plata, Md. Slides showed considerable lunar detail in Mr. Johnson's photographs with a 10-inch modified Gregorian reflector, with an f/18 focal ratio. By a Barlow lens, the effective focal length is increased to approximately 500 inches. A camera is placed immediately behind the Barlow lens when photographs are taken. Mr. Johnson's paper included advice on methods of processing films used for lunar photography.

"Why Nothing Ever Happens on the Moon" was the title of a paper by Dr. James C. Bartlett, Jr., of Baltimore, Md. In these days of astrophysics and cosmology, large professional instruments are rarely turned upon the moon. It is believed that possible lunar changes are very minute, requiring careful and continued scrutiny of the moon's surface to detect them. Here is another field left wide open to the serious amateur observer.

The liveliest time of the convention was provided by the juniors at their session on Sunday afternoon under the able direction of Clarence E. Johnson, Schenectady, N. Y., who will continue his work as chairman of junior activities. Tommy Gibson, Ft. Worth, Tex., described his recent visit to the Odessa meteor crater. The audience was then taken on a rocket trip to the moon via a radio broadcast recording made by members of the Junior Texas Astronomical Society. This was entertainingly presented by Barry Cohen, of Dallas. A question and answer panel discussion wound up the action for the afternoon.

Sunday evening, Paul W. Stevens, Rochester Academy of Science, conducted a session to hear impromptu eclipse reports. Those who viewed the eclipse had registered on a list giving their observing locations and sky conditions at eclipse time. Many of these observers were called upon to describe their experiences, and most of these are included in this issue of *Sky and Telescope,* page 374.

Instruments and amateur telescope construction furnished the theme for Monday morning's session, with Mr. Cave, of the Excelsior Telescope Club, presiding. John Neff, Milwaukee Astronomical Society, gave a description of that club's Lindblad camera for timing the total eclipse. Mr. Cave gave some hints on techniques of figuring mirrors to professional standards.

A total of 35 papers was presented at this year's convention. All of these, plus society and section reports, will be published in full in the *Proceedings,* copies of which may be ordered, for $1.50 each, from Russell C. Maag, 816½ Massachusetts Ave., Sedalia, Mo.

Special convention events included a visit to the Washburn Observatory of the University of Wisconsin, on the invitation of Dr. A. E. Whitford, and demonstrations of the Spitz planetarium of the department of astronomy by Dr. C. M. Huffer.

The official registration list shows that 231 persons attended from 22 states, the District of Columbia, and England. They came from Massachusetts and California, from Florida and Washington; 27 came from Illinois, 20 from Texas, and 17 from Pennsylvania. Almost 50 astronomical societies were represented. This was truly a national gathering.

Plans are already being made for the 1955 convention at the University of Washington in Seattle, July 1st through 4th. One of the attractions will be a boat trip to Victoria, B. C., and a visit at the nearby Dominion Astrophysical Observatory. This will be the first general convention the Astronomical League has held in its Northwest Region.

Astronomical League, University of Wisconsin, July 2-5, 1954.

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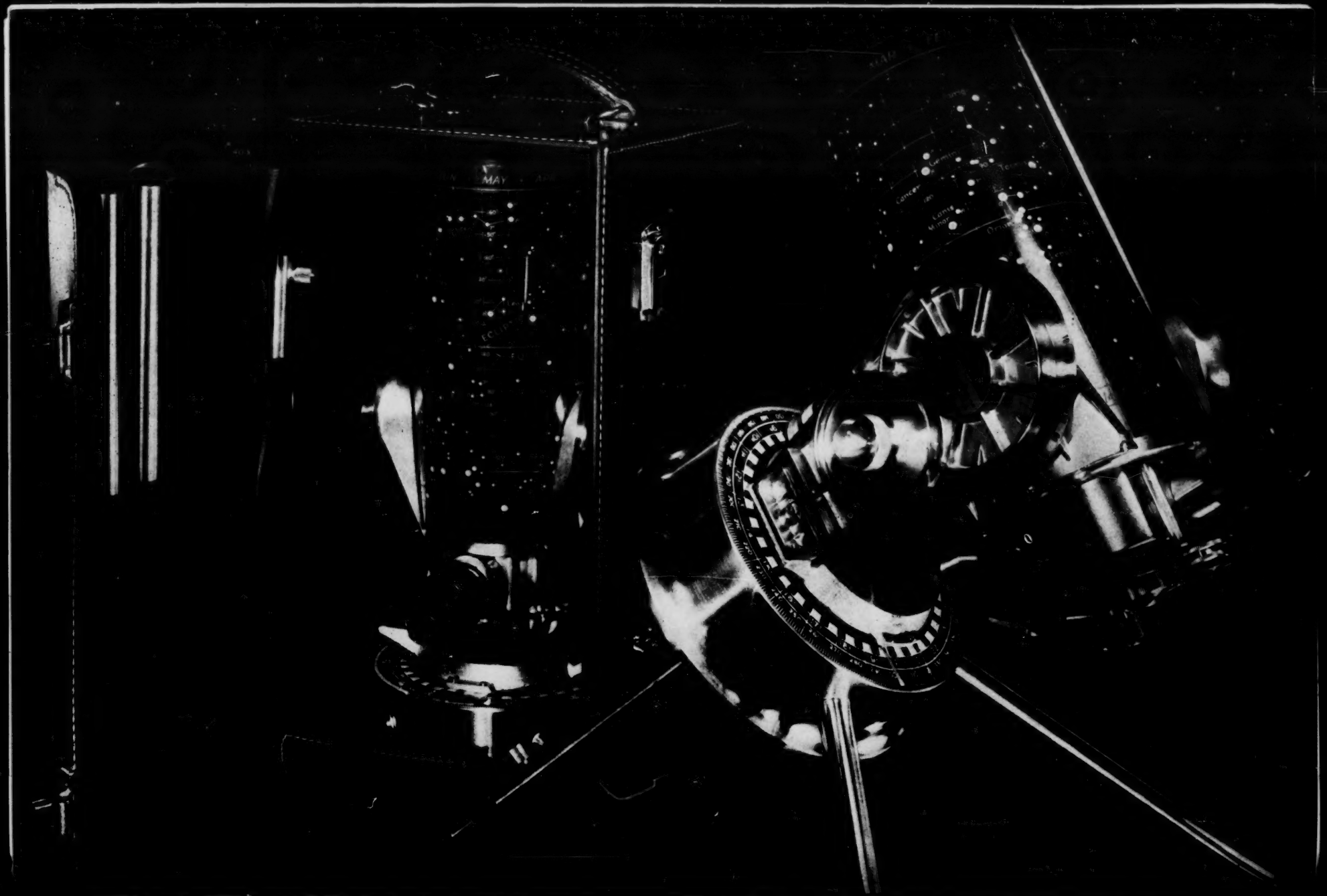

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BOOKS AND THE SKY

THE NATURE OF LIGHT AND COLOUR IN THE OPEN AIR

M. Minnaert. Dover Publications, New York, 1954. 362 pages. $3.95 cloth, $1.95 paper.

"THE PHENOMENA described in this book are partly things of everyday life, which it is fascinating to study from a scientific point of view, and partly things unfamiliar to you as yet, though they can be seen any moment, if only you will touch your eyes with the magic wand of 'knowing what to see.' And finally there are the rare, remarkable wonders of Nature, occurring only occasionally in a lifetime, so that even the most practised observer may wait year after year to see them. When he does see them he is filled to the very depths of his consciousness by the sense of their rareness, and by an ineffable feeling of pleasure."

With these words Professor Minnaert prefaces one of the most fascinating books ever written for the amateur scientist. He deals with the wealth of phenomena that can be studied without instrumental aid by any outdoors observer. Many of these, like twilight, have a seeming familiarity. But there are few of us who have watched the progress of twilight carefully enough to know the complex but regular stages in its pageantry, stages that can be readily recognized with the aid of Minnaert's clear description.

Apart from the rainbow, the varied luminous appearances in our atmosphere caused by water droplets and ice crystals are generally overlooked, if we have not been told when to watch or what to look for. Yet mock suns, halos, and light pillars through the sun are fairly common phenomena of considerable interest. It is valuable to have the systematic listing of the types of these apparitions as given in this book, for there is a great thrill in recognizing such rare phenomena as the anthelion or countersun. Some of these optical effects have been seen so infrequently that careful descriptions by amateur observers can have much scientific value.

Many of the topics are of immediate concern to the astronomical observer. Among these are star colors, the coloration displayed in lunar eclipses, and the naked-eye appearance of the Milky Way and zodiacal light. Contrast effects are of considerable importance to the thoughtful planetary observer, who wishes to distinguish between real and illusory detail. Scintillation of the stars offers an interesting field for amateur study, particularly if the intensity of twinkling is estimated on a numerical scale, as Minnaert suggests.

An unusual aspect of the book is that the author writes not only as a competent scientist but as an artist. Thus he describes how the colors in a landscape are changed when it is illuminated by moonlight or by twilight, and the varied colors of the sea and lakes.

The author is a well-known astronomer at the Utrecht Observatory who has made important contributions to photometry and solar physics. **The Nature of Light and Colour in the Open Air** originally appeared in Dutch. In 1940 a translation by H. M. Kremer-Priest was published in England, in a small edition that soon went out of print, and few copies reached this country. This has now been reprinted, with the original illustrations, and we are indeed fortunate to have this delightful and informative book generally available.

J. A.

NEW BOOKS RECEIVED

SIR ISAAC NEWTON, *E. N. da C. Andrade*, 1954, *Macmillan*. 140 pages. $1.75.

Professor Andrade is an outstanding authority on Newton. Writing for the general reader, he describes Newton's life and work in astronomy, mathematics, and optics, and his less well-known activities as currency reformer, alchemist, and theologian.

The book is an import from Great Britain, where it was published by Collins as the 11th in their series of Brief Lives.

THE NATURE OF SCIENCE AND OTHER LECTURES, *Edwin Hubble*, 1954, *Huntington Library*, San Marino 9, Calif. 83 pages. $2.00.

Three hitherto unpublished lectures to general audiences deal with "The Nature of Science," "Science and Technology," and "Experiment and Experience." The other three addresses are concerned with World War II and the scientist in wartime.

ASTROPHYSICS: NUCLEAR TRANSFORMATIONS, STELLAR INTERIORS, AND NEBULAE, *Lawrence H. Aller*, 1954, *Ronald Press*. 291 pages. $12.00.

A companion volume to the same author's *Astrophysics: The Atmospheres of the Sun*

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and Stars, this is a textbook designed for the graduate student in astrophysics. It combines both the theoretical and the observational viewpoints. In addition to the topics indicated by the title, variable stars, stars with extended atmospheres, and the interstellar medium are treated in considerable detail.

OTTICA INDUSTRIALE, *Domenico Argentieri*, 1954, *Ulrico Hoepli*, Milan, Italy. 466 pages. Lire 3,000, paper bound.

This book, in Italian, deals primarily with the design of simple optical systems by the methods of geometrical optics. Much space is devoted to an analytical development of dioptrics. Other sections consider more briefly lens aberrations, tolerances, and resolving power. It is surprising to find in such a book several pages on a variation in the velocity of light, particularly as little indication is given that this once much-discussed idea is now generally discredited.

The first edition appeared in 1942, but the publisher's stock was destroyed in the war. The second edition is a revision and enlargement.

ZWEITER KATALOG DER ASTRONOMISCHEN GESELLSCHAFT, Vols. 5-9, *R. Schorr and A. Kohlschuetter*, 1952-3, *Hamburger Sternwarte in Bergedorf*, Hamburg-Bergedorf, Germany. 239, 257, 266, 266, and 308 pages. Each $8.00, paper bound.

Accurate positions of 61,820 stars between declinations +25° and +50° and 9th magnitude or brighter are given by five-degree zones in these five parts of the *Second Catalogue* of the Astronomische Gesellschaft. The positions, which are for 1950, were measured from photographs secured at the Bergedorf and Bonn observatories around 1930. Proper motions are not given for these stars.

Volumes 1-4, which began to appear in 1951, cover the sky from the north pole to declination +50°.

BERGEDORFER SPEKTRAL-DURCHMUSTERUNG, Vol. 5, *A. Schwassmann and P. J. van Rhijn*, 1953, *Hamburger Sternwarte in Bergedorf*, Hamburg-Bergedorf, Germany. 295 pages. $8.00, paper bound.

The fifth volume of the Bergedorf catalogue of spectral types and photographic magnitudes gives these data for 32,491 stars down to magnitude 13, in 24 regions centered on the celestial equator, each 3½ by 3½ degrees. This and the four preceding volumes, which appeared in 1935 to 1951, complete a catalogue of 173,599 stars in Kapteyn's Selected Areas 1-115.

A BRIEF TEXT IN ASTRONOMY, *William T. Skilling and Robert S. Richardson*, 1954, *Henry Holt*. 327 pages. $4.00.

This is a condensation and revision of the same authors' *Astronomy*. It is intended for use in one-semester college courses.

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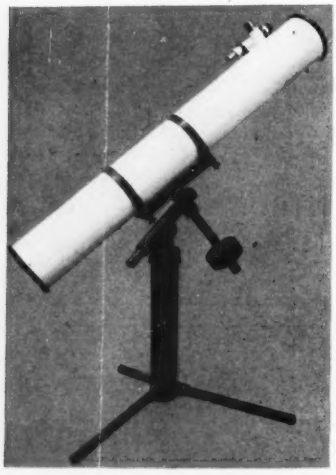

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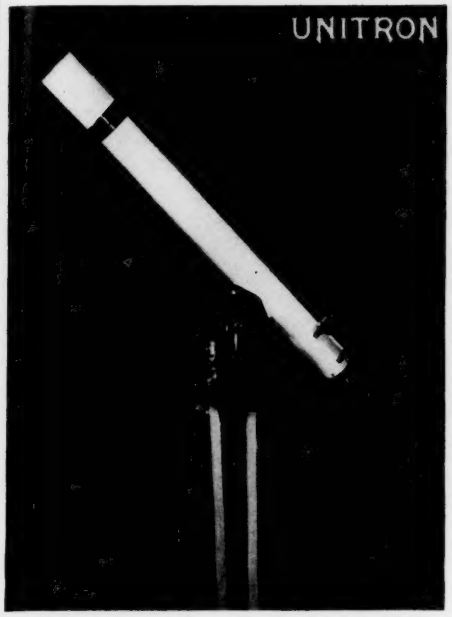

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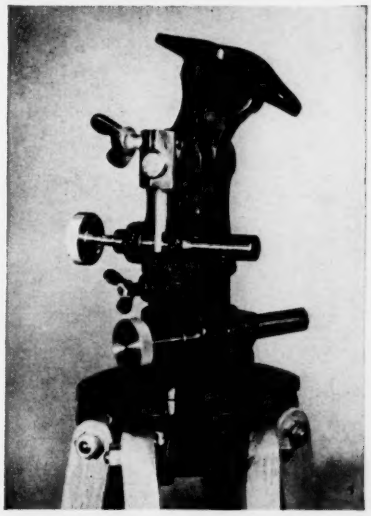

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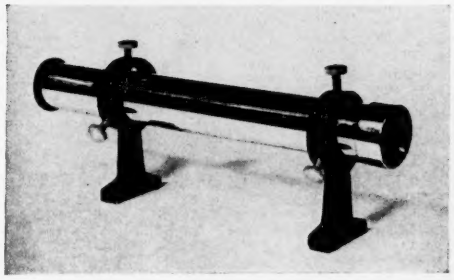

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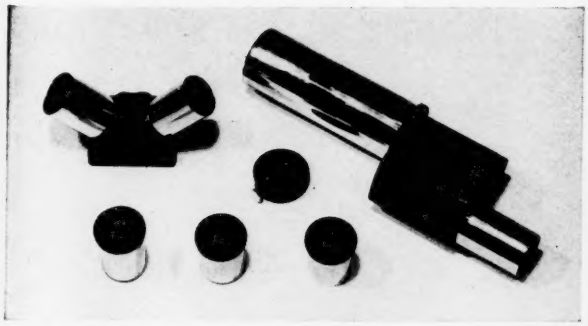

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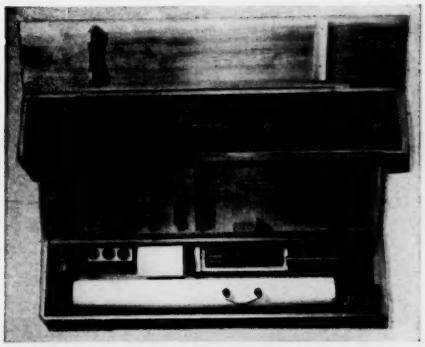

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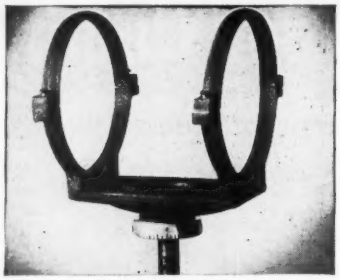

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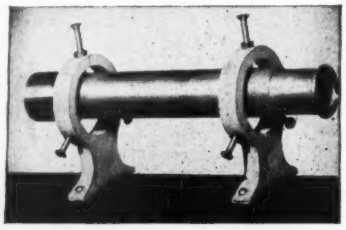

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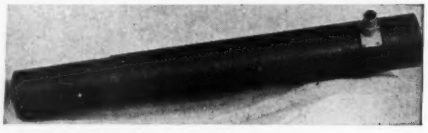

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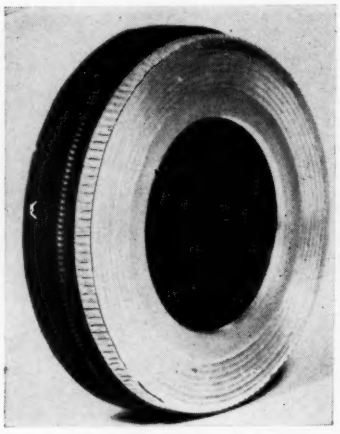

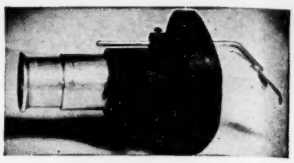

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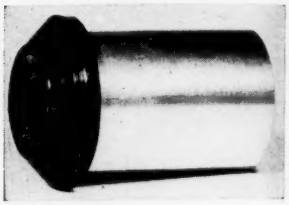

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NOTES ON BASIC OPTICS — IX

J. Plane Mirrors

Plane mirrors are very useful in optical systems for bending light around corners, for inverting and for rotating images, as well as for such techniques as scanning and folding. An understanding of the image-forming properties of plane mirrors is of the utmost importance to the designer of optical systems. Yet these properties are not as obvious as the simplicity of the mirror itself might suggest.

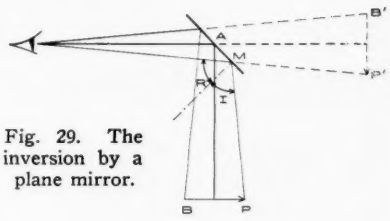

Fig. 29. The inversion by a plane mirror.

1. **Image Formation.** Consider a plane mirror used as in Fig. 29 to observe an object lying at 90° to the line of sight. A ray from the point **P** will enter the eye, and will appear to emanate from the point **P'**, the position of which is found from the law of reflection (the angle of reflection, **R**, equals the angle of incidence, **I**) and from the fact that the mirror is plane — hence it has no optical power and **MP'** = **MP**. This same analysis applies to other points in the object **BP**, for which the image **B'P'** is, of course, virtual, according to the definition given in our discussion for May, 1953.

2. **Image Inversion.** The image **B'P'** is inverted, because, if the object **BP** were rotated about the point **A** into the position occupied by **B'P'**, the two would be inverted with respect to each other. It is clear that the image is inverted in one plane only — the plane of the paper — and there is no inversion in the perpendicular plane. The axis of inversion is the line, perpendicular to the paper, through the point **A**. Thus, a plane mirror produces an inversion in one plane, about an axis that lies in the plane of the mirror and is perpendicular to the line of sight.

3. **Two-mirror Inversion.** To understand what happens when a second mirror is added to the first, examine Fig. 30a carefully. Here the object lies in a horizontal plane, from which the light proceeds downward and is reflected horizontally by a mirror set at an angle of 45° to the incoming rays. This mirror produces rotation about the horizontal axis of rotation, **A**, affecting that part of the image extending in the direction of the small circle, but not affecting the image in the direction of the arrow.

On striking the second mirror, whose axis of rotation, **A'**, is vertical (and hence perpendicular to that of the first mirror),

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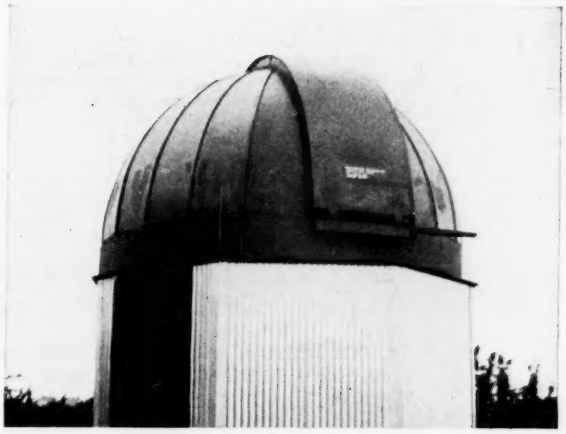

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the part of the image represented by the small circle is reflected without change, but the part with the arrow is inverted. Together, the mirrors have produced inversion in two planes perpendicular to each other.

This inversion in two mutually perpendicular planes is equivalent to the inversion produced by a lens, as described in July, 1953. Hence, a pair of mirrors can serve as an erecting system, counteracting the inversion, for instance, of the objective lens of an astronomical telescope.

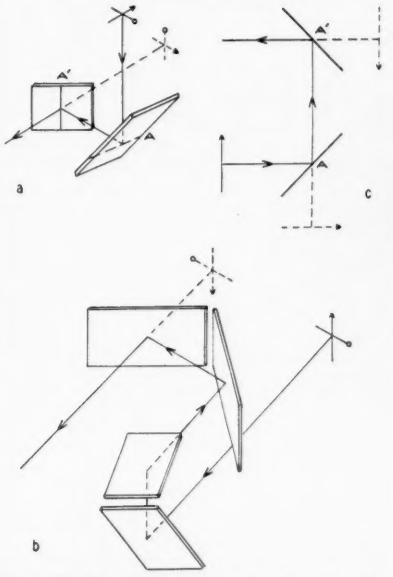

Fig. 30. Several systems of mirrors and the inversion effects they produce. The arrows show the direction that the light travels from the object through the mirror system to the eye.

4. **Four-mirror Inversion.** But, the two mirrors in Fig. 30a look out at 90° to the original line of light, and it is necessary to add two more mirrors to overcome this disadvantage and procure a direct line of sight, as shown in Fig. 30b. The effect of this arrangement, which serves as the erecting system in most binoculars, is to invert the image in two perpendicular planes and to maintain the final line of sight parallel to the line of light from the original image.

5. **Definition of Inversion.** It is evident that we have been a little arbitrary about our decisions as to when an image is inverted and when it is not. The situation in Fig. 29 is clear enough, but what happens in Fig. 30c? If we apply the rotation rule here, the arrow is not inverted, for it can be rotated around axis **A'** into coincidence with the final image produced by these two mirrors (which have their rotation axes parallel).

We must add to our definition the further rule that any bending of the line of sight through 180° is equivalent to an inversion. This is not a very satisfactory way out, and it is not rigorous, but it is the best rule we can offer at present. No one has yet devised a simple manner of treating inversions that will cover all cases.

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Fig. 30c, the first of which inverts the arrow because of the 180° effect, and the second of which inverts the small circle for the same reason. The result is that the image is inverted in two mutually perpendicular planes, as we have seen.

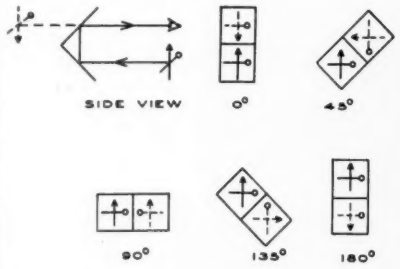

Fig. 31. Image rotation by mirrors.

6. **Image Rotation.** Consider what occurs if we rotate the arrangement of Fig. 30c about the optical axis. It is clear from Fig. 31 that, as the mirror arrangement is rotated about the optical axis, the image rotates about the line of sight at double speed. Therefore, although the mirror arrangement is turned through only 180° in Fig. 31, the image has turned through 360°, and is again oriented as it was at 0°. This property of certain mirror arrangements is of great value in many optical systems.

To have the property of image rotation, the mirrors must combine to satisfy two conditions: They must not deviate the line of sight (except through a multiple of 180°), and they must present an image that is inverted in one plane. It is evident that the four-mirror arrangement of Fig. 30b does not have the property of image rotation.

7. **Right- and Left-handedness.** The description of image orientations in terms of inversions in one or two perpendicular planes is not very satisfactory, as explained above. The following rules, while again not rigorous, are very convenient in the discussion of optical systems:

Rule 1. An image is said to be right-handed if rotation about the optical axis will bring it into alignment with the object. If such rotation can not bring about alignment, the image is said to be left-handed.

Rule 2. Any optical system containing an odd number of reflections gives a left-handed image. Conversely, an even num-

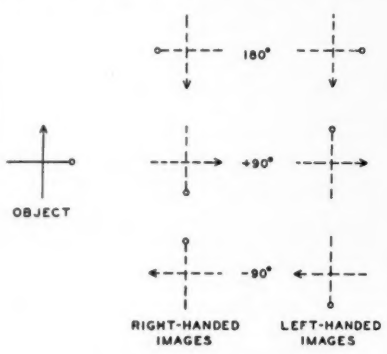

Fig. 32. Image orientations.

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ber of reflections (or no reflections) yields a right-handed image.

The application of Rule 1 is illustrated in Fig. 32, in which the direction of rotation is positive if clockwise. It is evident that no amount of rotation can bring the left-handed images into the orientation of the object.

(To be continued)

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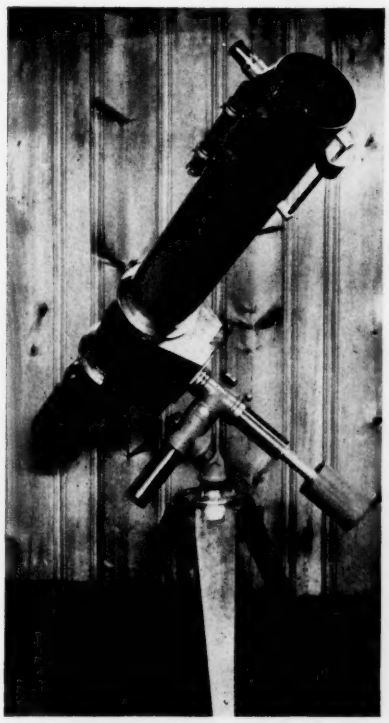

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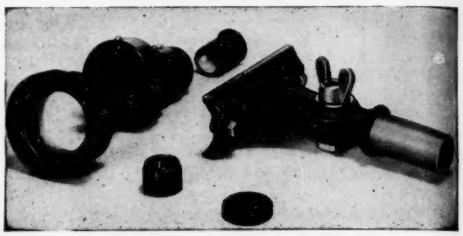

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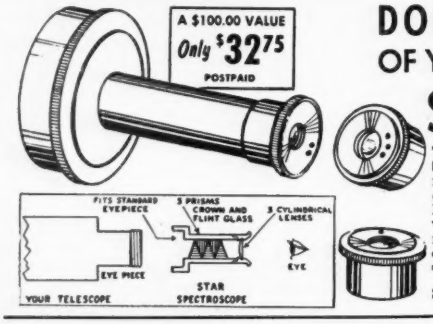

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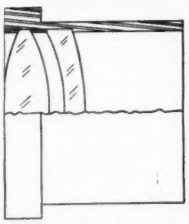

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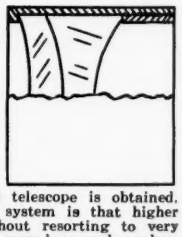

E.F.L.: —1.74 ± 0.01 inches
CLEAR APERTURE: 0.96"
O.D. OF CELL: 1-3/16"

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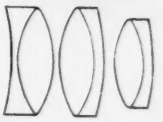

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M-7
8 Power

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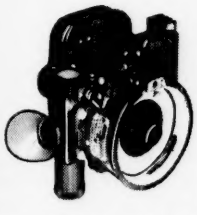

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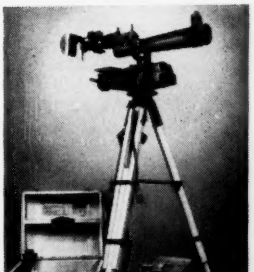

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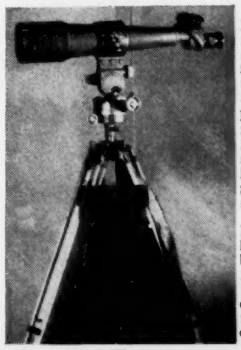

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OBSERVER'S PAGE

Universal time is used unless otherwise noted.

Double Stars in a 3-inch Refractor

HOW CAN an amateur observer predict whether any particular double star will be split by his telescope? The separation of the closest double star resolvable by a telescope of **A** inches aperture is 4.56/**A** seconds of arc, according to Dawes' well-known empirical formula, provided the components are equal in brightness and are about the 6th magnitude.

Experience shows that fainter or very unequal pairs may not be resolved, even though considerably wider than Dawes' limit, and the prediction cannot be made as simply as that formula would at first appear to indicate. At the 1952 meeting of the Mid-States Region of the Astronomical League, S. L. O'Byrne explained a prediction formula that he had evolved for his own 2-inch refractor when it was equipped with a 33x eyepiece.

From extensive observations he had concluded that the main factor was the difference in magnitude between the fainter component and the magnitude limit of the telescope, rather than the difference between the components of the double star. The wider the pair, however, the dimmer the companion that could be seen. Mr. O'Byrne asked other amateurs to derive similar formulae for their own instruments, to see if a general formula valid for any telescope could be devised.

My program for 1953 was to work out a formula for my 3-inch refractor. For uniformity, all observations were made with a single eyepiece, a 1-inch Kellner type giving 45 power. This did not always make possible using the full resolving power of the objective, but it did facilitate selection of the list of double stars. A star diagonal was used. With the telescope thus equipped, its limiting magnitude for single stars was determined from a series of observations to be about 11.1.

Observations were made when the seeing was good enough for the companion of Polaris to be readily seen, and when the doubles to be examined were near the meridian. The Skalnate Pleso **Atlas of the Heavens** was of great value in identifying the double stars.

The results of the examination of a long list of double stars are given in the diagram, where the magnitude of the fainter component is plotted vertically, and the logarithm of the separation in seconds of arc is plotted horizontally. The pairs that can be easily resolved will plot in the upper right part of the graph.

For companions brighter than magnitude 8.7, the division between resolved and unresolved pairs is a vertical line at separation 3".0; this is the limit of resolution of the telescope with the 45x eyepiece. When the secondary star is fainter than magnitude 8.7, in other words, within 2.4 magnitudes of the limiting magnitude or threshold of the telescope, the boundary line slopes downward toward wider separations. This matches the findings of Mr. O'Byrne.

From these results, a general formula can be proposed for the magnitude, **m**, of the faintest companion likely to be seen:

$$\mathbf{m = L - 2.4 + 1.6 \log D/S,}$$

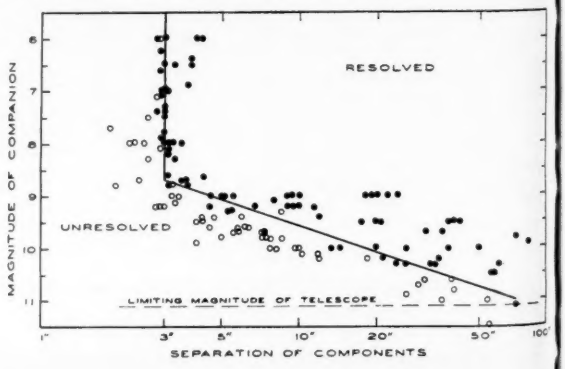
where **L** is the limiting magnitude of the telescope for a single star, **D** is the separation in seconds of arc of the pair under observation, and **S** is the limit of resolution on bright pairs for the eyepiece used.

Olcott's **Field Book of the Skies** lists about 323 doubles with companions from 4.5 to 11.5 magnitude and with separations between one and 100 seconds. According to the formula, about 306 are resolvable with a 3-inch, 45x refractor. This has actually been my experience.

The 451 double stars discovered by Burnham with a 6-inch refractor, when plotted in such a diagram, show the same kind of dividing line. Two additional plots, of all Wilhelm Struve's double stars found with a 9-inch, and of about three quarters of those found by the elder Otto Struve with a 15-inch, show similar boundary lines, but with somewhat steeper slopes.

For any specific small telescope, an observer can derive a formula such as this from a series of observations patterned along those proposed by Mr. O'Byrne. I shall be glad to receive correspondence and to answer questions on my own program.

HAROLD H. PETERSON
140 W. 22nd St.
Durango, Colo.



Dots represent double stars resolved by Mr. Peterson with a 3-inch 45x refractor; circles indicate pairs unresolved during his tests.

OCCULTATION PREDICTIONS

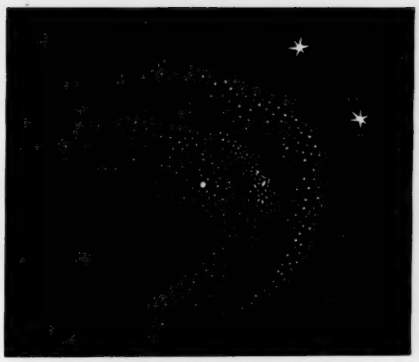
Data for the emersion of 132 Tauri at station **H** on September 18-19 was published in the August issue.

DEEP-SKY WONDERS

OF all the deep-sky objects, none are so well suited to amateur equipment as the galactic clusters. Here we have groupings well separated into individual stars, so that internal structure may be observed. It is possible to make counts of stars and to write clear descriptions. While galaxies and globular clusters may disappoint the amateur, as in his instrument they do not equal the photographs made with the great reflectors, the galactic clusters offer rich detail to almost any size of telescope.

Yet, with a very few exceptions such as the Double Cluster in Perseus, the Pleiades, and some others, the galactic clusters are seldom reproduced in books or journals. NGC 6705, M11, at $18^h\ 48^m.4$, $-6°\ 20'$ (1950) is a case in point. Here is a marvelous object for the amateur, seldom seen in photographs except in small-scale views of the whole Scutum cloud. Yet it is easily found in northern Scutum without charts, and is visible to the naked eye, as Sir William Herschel pointed out many years ago. A 2-inch breaks it into individual stars, and a good 10-inch, on a good night, shows hundreds of glittering star points all over the field of view. Smyth compares the cluster to "a flight of wild ducks"; the Rev. T. W. Webb writes, "noble fan-shaped cluster," and quotes d'Arrest, "a magnificent pile of innumerable stars."

Kirch, who discovered the cluster in 1681, saw it only as a pale cloud in his small telescope; it was first resolved into stars about 1733, when Derham viewed it in a reflector of eight-foot focal length. Modern reflectors show M11 much as Smyth describes it, as a triangular patch of dozens of small stars, many of them weaving in and out of sight with transient changes in the atmosphere and the observer's eye. With best seeing, the wild-duck aspect is pronounced, but a trace of cirrus or haze blunts the leading point and the comparison vanishes.



M11: A 6-inch view by Smyth (1835).

The catalogues of Shapley and Trumpler do not make M11 larger than 10 to 13 minutes of arc; however, Barnard contends its extreme outliers take in 35 minutes or more. Visual observations, to me at least, seem to confirm the larger figure. Other amateurs who estimate this diameter might drop me a postcard.

When a very transparent night comes, try a slow and patient study of this host of suns. If you own a Barlow lens, by all means use it, for it darkens the sky background and enables the fainter stars to come sparkling through. Averted vision is most helpful. A leisurely study of this cluster under optimum conditions provides great observing satisfaction.

WALTER SCOTT HOUSTON

VISUAL SIZE OF THE ANDROMEDA NEBULA

Robert Jonckheere, of the Marseilles Observatory, has looked into the question of how large the great Andromeda nebula appears visually under the most favorable circumstances, and reports his findings in the April issue of the **Observatory.** He used prismatic binoculars of 2-inch aperture, with all optical components coated. Care was taken to have the eyepieces correctly centered on the eyes, so that both pupils were fully used, and the observer remained in total darkness, with his eyes open, for 10 minutes before observing. All external light was excluded, except from the region of the sky to be examined.

With these precautions, Jonckheere found on very transparent nights that the observed length of M31 was 5° 10′, and the width 1° 05′. The nucleus was much nearer the northern end of the minor axis. These dimensions were determined with the aid of stars whose positions were known. To locate the boundaries with more precision, it was found helpful to move the binoculars to and fro.

Jonckheere points out that this is a greater extent than can be recorded photographically, even with Schmidt cameras, which do not show M31 much more than 3° 20′ in length.

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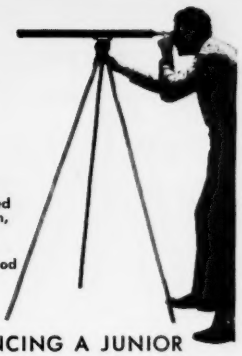

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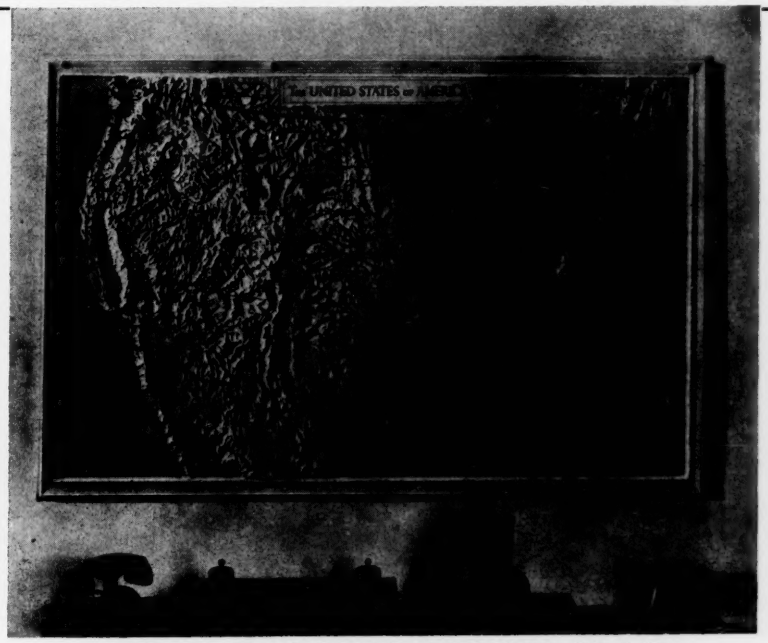

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VENUS-MOON CONJUNCTION

During daylight hours on the afternoon of September 30th, observers throughout the United States will be able to watch the crescent moon pass less than a degree north of the planet Venus. The moon will be three days past new, and Venus, near maximum brightness at magnitude −4.3, should be distinctly visible to the naked eye by daylight, if the air is very clear. An expert photographer might be able to photograph the conjunction in infrared light.

Both the time of closest approach and the least separation will depend on the observer's geographical location, because of lunar parallax. Seen from the center of the earth, Venus and the moon will have the same right ascension at 22:14 UT, and will be closest nine minutes later, when they are 1° 13′ apart. The same figures for nearest approach will hold for the spot on the earth's surface where the moon is directly overhead at that time: longitude 118° 22′ west, latitude 21° 26′ south, in the Pacific Ocean. Approximately speaking, the conjunction will be visible over the hemisphere of the earth centered on this point.

In the United States, the separation of Venus and the moon will be well under 1° 13′, but no occultation will occur. The closest approach will be seen from near Great Slave Lake in northwest Canada, where in latitude 67° 54′.4 north, Venus will be on the southern horizon, only 15′.4 below the moon's lower limb.

As in occultations, the time of least distance between the centers of the moon and Venus changes with geographical location. For observers in North and South America, the effect of lunar parallax is to make closest approach **earlier** than the geocentric time, 22:23 UT. The greatest advance will be 59 minutes, at a place in the Atlantic Ocean where conjunction occurs at moonset.

FINDING VENUS BY DAY WITH THE NAKED EYE

This ephemeris continues that on page 353 of the August issue, where a detailed explanation was given in the article by Franklin Miller, Jr. Example: Suppose an observer locates Alpha Capricorni, magnitude 3.8, on the evening of September 1st, noting that it is in line with a flagpole or other mark at, say, 9:00 p.m. Then Venus will be similarly placed with respect to the mark 17 hours 15 minutes later, or at 2:15 p.m. on September 2nd. The difference in declination between Venus and the finder star or other object is always less than about two degrees; the letter N means that Venus will be slightly farther north than the star.

Alpha (α) Capricorni, 3.8: Sept. 1, 17:15, N; 2, 17:19.

Beta (β) Capricorni, 3.3: Sept. 3, 17:19, N; 4, 17:22, N; 5, 17:26, N; 6, 17:29, N; 7, 17:33, N; 8, 17:36; 9, 17:40, S.

Delta (δ) Capricorni, 3:0: Sept. 10, 16:17, N; 11, 16:21; 12, 16:24, S; 13, 16:28, S; 14, 16:31, S; 15, 16:34, S; 16, 16:38, S.

Pi (π) Sagittarii, 3.0: Sept. 17, 19:18, N; 18, 19:22, N; 19, 19:25, N; 20, 19:28, N; 21, 19:31, N; 22, 19:34, N; 23, 19:37, N; 24, 19:40; 25, 19:43, S; 26, 19:46, S; 27, 19:49, S; 28, 19:52, S; 29, 19:55, S; 30, 19:59, S.

Mars, −0.4: Oct. 1, 19:48, N; 2, 19:48, N; 3, 19:48, N; 4, 19:48, N; 5, 19:47, N.

PREDICTIONS OF BRIGHT MINOR PLANET POSITIONS

Phocaea, 25, 9.6. Sept. 15, 0:56.5 +26-03; 25, 0:50.0 +23-34. Oct. 5, 0:42.4 +20-28; 15, 0:35.3 +17-03; 25, 0:29.9 +13-39. Nov. 4, 0:27.0 +10-36.

After the asteroid's name are its number and the magnitude expected at opposition. At 10-day intervals are given its right ascension and declination (1954.0) for 0^h Universal time. In each case the motion of the asteroid is retrograde. Data are supplied by the IAU Minor Planet Center at the University of Cincinnati Observatory.

MINIMA OF ALGOL

September 1, 0:45; 3, 21:33; 6, 18:21; 9, 15:10; 12, 11:59; 15, 8:48; 18, 5:37; 21, 2:25; 23, 23:14; 26, 20:03; 29, 16:52. October 2, 13:40; 5, 10:29; 8, 7:18.

These minima predictions for Algol are based on the formula in the 1953 **International Supplement** of the Cracow Observatory. The times given are geocentric; they can be compared directly with observations.

VARIABLE STAR MAXIMA

September 12, SS Virginis, 122001, 6.9; 15, T Centauri, 133**63**, 6.1; 19, V Bootis, 142539a, 7.9; 20, R Sagittarii, 191019, 7.2. October 6, R Reticuli, 043**263**, 7.7.

These predictions of variable star maxima are by the AAVSO. Only stars are included whose mean maximum magnitudes are brighter than magnitude 8.0. Some, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern), and the predicted magnitude.

SUNSPOT NUMBERS

American sunspot numbers for June, communicated by the AAVSO Solar Division, were zero on all dates except for June 1, 2; 2, 1; 22, 1; 23, 1. Provisional Zurich numbers, sent by Dr. M. Waldmeier, were zero on every date in June except for June 2, 6. Monthly mean for June: 0.2 American; 0.2 Zurich.

Sunspot numbers for 1953, as determined by 12 Polish observers, have been reported by J. Mergentaler in **Urania**. The monthly means are: January, 19.5; February, 3.2; March, 8.0; April, 23.3; May, 10.6; June, 19.3; July, 6.5; August, 23.2; September, 14.9; October, 7.3; November, 1.6; December, 1.0.

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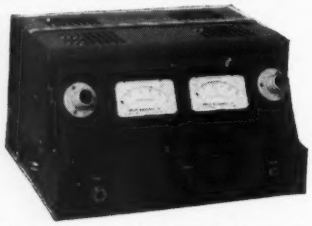

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NEWS NOTES

(Continued from page 371)

to return in 1954 were picked up during July: Reinmuth II on the 5th, Faye on the 25th, and Schwassmann-Wachmann II on the 28th. All three were very faint objects, of about magnitude 17.

A 7.5-magnitude nova in Scorpius was discovered on July 4-5, at the National Astrophysical Observatory, Tonanzintla, Mexico, by Guillermo Haro and Lauro Herrara. Dr. Haro, director of the observatory, stated that the nova was not bright enough to be recorded on a plate of the same region taken three nights earlier. The nova's position is $17^h\ 55^m.5$, $-36°\ 15'$ (1950 co-ordinates).

A second nova has been found in Ophiuchus, by Victor Blanco on a spectrum plate that was taken July 2nd at the Warner and Swasey Observatory. On that date it was about magnitude 9; it faded rapidly, being fainter than 14 on the 27th, according to observations at the Dyer Observatory by C. Seyfert and K. Yoss.

DIURNAL VARIATION OF OZONOSPHERE TEMPERATURE

The ozone layer in our atmosphere, which absorbs much ultraviolet radiation from the sun, should undergo a change in temperature throughout the day and night. Theoretical calculations are discordant, indicating variations as low as 0.3° and as great as 30° C. Heretofore no satisfactory measurements of such a diurnal change have been available. Scanty data from Aerobee rockets have indicated that the range should be about 5° to 6° at a height of 48 kilometers, but the rocket data have the disadvantage of not being a continuous record.

In *Current Science,* A. U. Momin, of the Meteorological Office at Poona, India, reports on measurements he has made, using an infrared spectroscope. He compared the emission of the atmospheric ozone layer with that of a controlled laboratory source, at a wave length of 9.6 microns — the center of an ozone band. The observations could be made whenever there was a patch of clear sky near the horizon.

Measurements obtained in May, October, and November, 1953, show a temperature variation of about 15° C.; the temperature climbs slowly to a peak shortly after noon, falls sharply until 4 p.m., and then stays close to minimum (about 220° absolute) until sunrise. The records for May indicated somewhat higher temperatures on the average, suggesting the possibility of a seasonal variation. The author stresses that further observations would be needed for more definite conclusions.

A HANDY STAR BOX

HAVING fumbled with books and flashlights too long, I built a simple device which has proved to be a very useful accessory at the telescope. A star map was photographed on a strip of 35-mm. film and mounted in the form of a cylinder. This was placed in a box with an inexpensive magnifier set in the cover.

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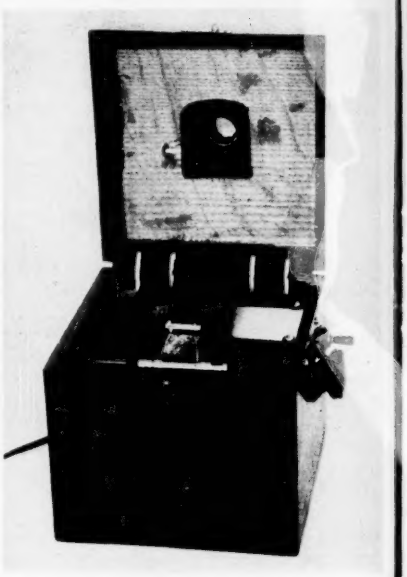

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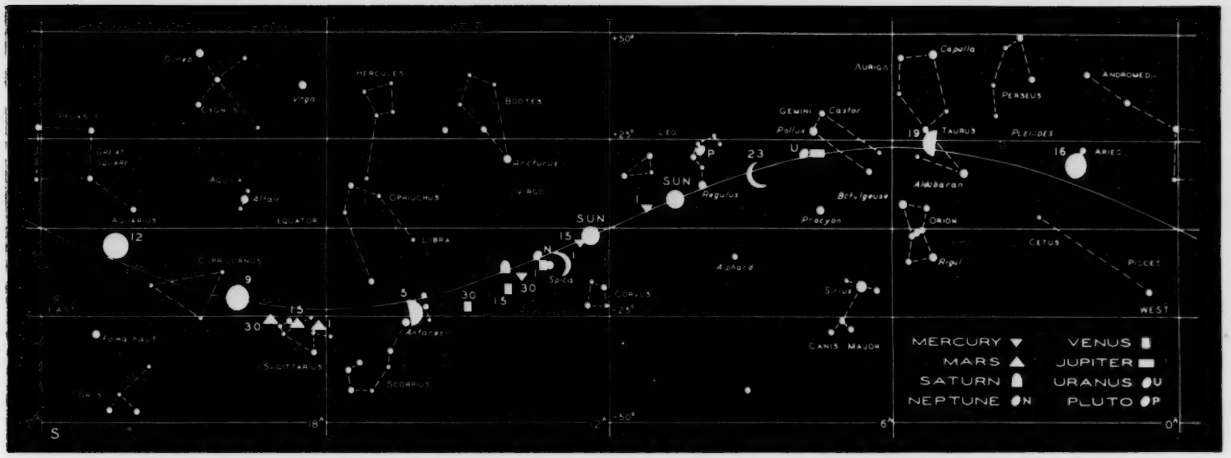

THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.

Mercury will be in the evening sky all September, but poorly placed for observers in northern latitudes. By the end of the month, the planet will be at magnitude +0.1, setting three quarters of an hour after the sun.

Venus arrives at greatest elongation on September 6th, 46° 14′ east of the sun. Well south of the sun, Venus appears low in the southwestern sky, setting about 1½ hours after sunset. The planet shines at magnitude −4.0, and may be seen in daylight, as explained on page 398. Telescopically, Venus on the 6th will be near half phase, with a diameter of 25″.

Earth arrives at heliocentric longitude 0° on September 23rd at 13:56 UT. Autumn commences north of the equator and spring in southern latitudes.

Mars may be viewed only during evening hours; it is on the meridian shortly after sunset and reaches the horizon before midnight. Low in the southern sky, the red planet is traveling eastward in Sagittarius. It fades from magnitude −1.0 to −0.4 in September, presenting a disk 13″ in diameter on the 15th. On the 20th, Mars will pass less than 2′ south of the 2nd-magnitude star Sigma Sagittarii, as described on this page.

Jupiter, at magnitude −1.6, rises at midnight by the end of September. The giant planet moves eastward, south of Pollux in Gemini. The Jovian disk is 35″ in equatorial diameter on the 15th.

Saturn sets shortly after evening twilight ends. It will be close to Venus in the sky for the remainder of the year, and the two planets will be in conjunction three times. The first conjunction takes place on September 16th, with Saturn 6° 8′ north of Venus. September will be the last opportunity for a telescopic view of Saturn in the evening sky this year. The ring system is inclined 17°.7 to our view at the beginning of the month.

Uranus rises shortly after Jupiter, and will be near it all month. Appearing of the 6th magnitude, Uranus crosses from Gemini into Cancer at the end of September.

Neptune will be low in the western sky at sunset and difficult to view. Venus passes 4° 9′ south of Neptune on the 2nd.

E. O.

MOON PHASES AND DISTANCE

First quarter	September	5, 12:28
Full moon	September	12, 20:19
Last quarter	September	19, 11:11
New moon	September	27, 0:50
First quarter	October	5, 5:31

		Distance	Diameter
September			
Apogee 2,	22h	251,600 mi.	29′ 30″
Perigee 14,	20h	225,000 mi.	33′ 00″
Apogee 30,	14h	252,300 mi.	29′ 26″
October			
Perigee 13,	2h	222,500 mi.	33′ 22″

UNIVERSAL TIME (UT)

TIMES used on the Observer's Page are Greenwich civil or Universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the UT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown.

APPULSE OF MARS TO A BRIGHT STAR

Observers whose telescopes are fitted with circles can pick up an unusual daylight spectacle on the morning of September 20th. In the field of view with Mars will be a 2nd-magnitude star less than eight diameters of the planet away. The closest approach of Mars to Sigma Sagittarii will be at 17:01 UT, when the planet passes 1.6 minutes of arc south of the star. On this date the magnitude of Mars is −0.6, and the star is +2.1. The co-ordinates of Mars are 18h 52m.5, −26° 23′.

Naked-eye and field glass observers can watch the eastward motion of Mars past the star on the evenings before and after the conjunction. An interesting effect to look for is whether the normally bluish-white color of the star (whose spectral type is B1) becomes greenish by contrast when the red planet is very near it.

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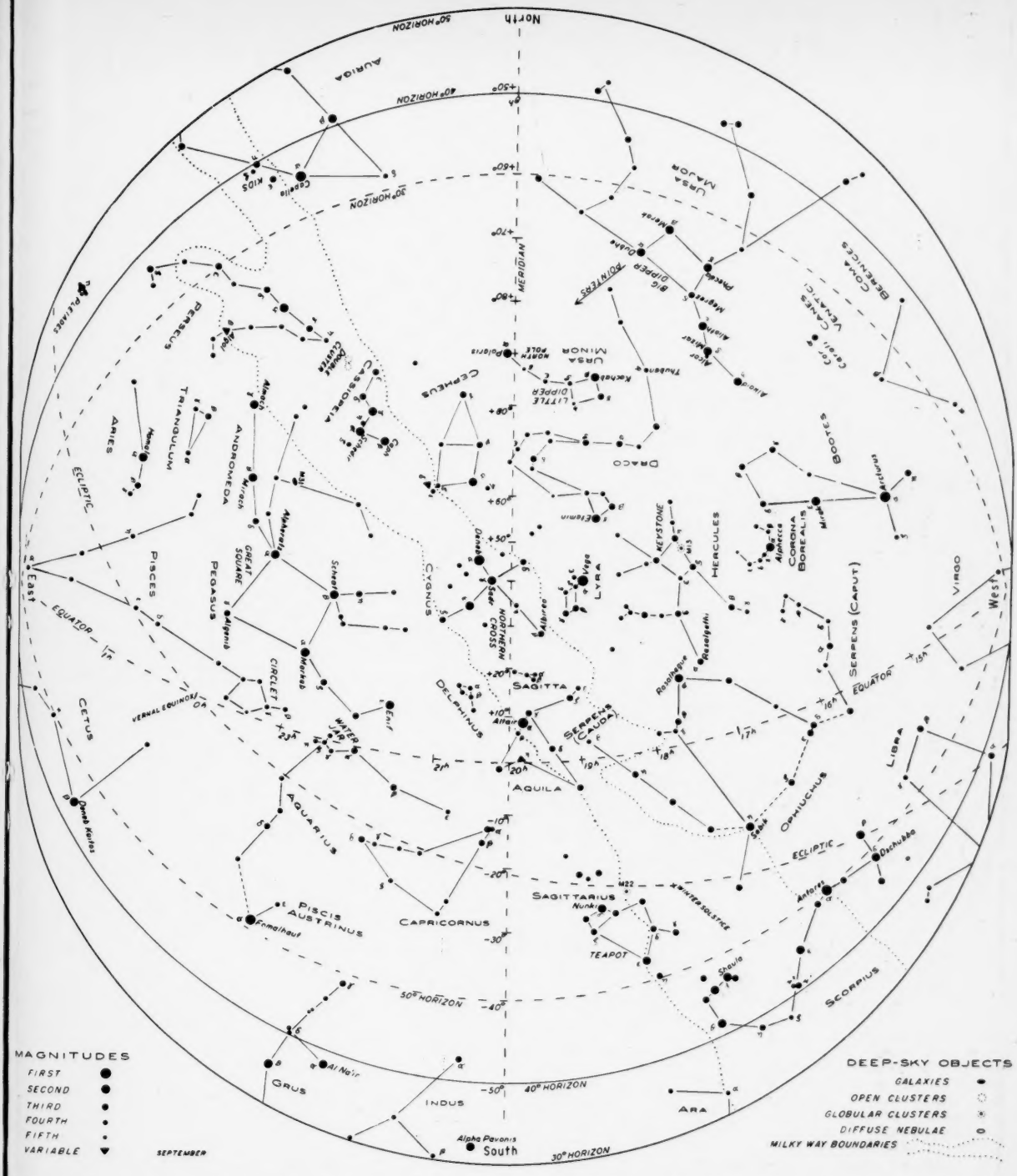
SOUTHERN STARS

The sky as seen from latitudes 20° to 40° south, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of December, respectively; also, at 7 p.m. and 6 p.m. on January 7th and 23rd. For other times, add or subtract ½ hour per week. When facing south, hold "South" at the bottom; turn the chart correspondingly for other directions. Celestial hour circles and parallels are represented as parts of circles, and an observer's horizon is always a circle on the stereographic projection used in this chart.



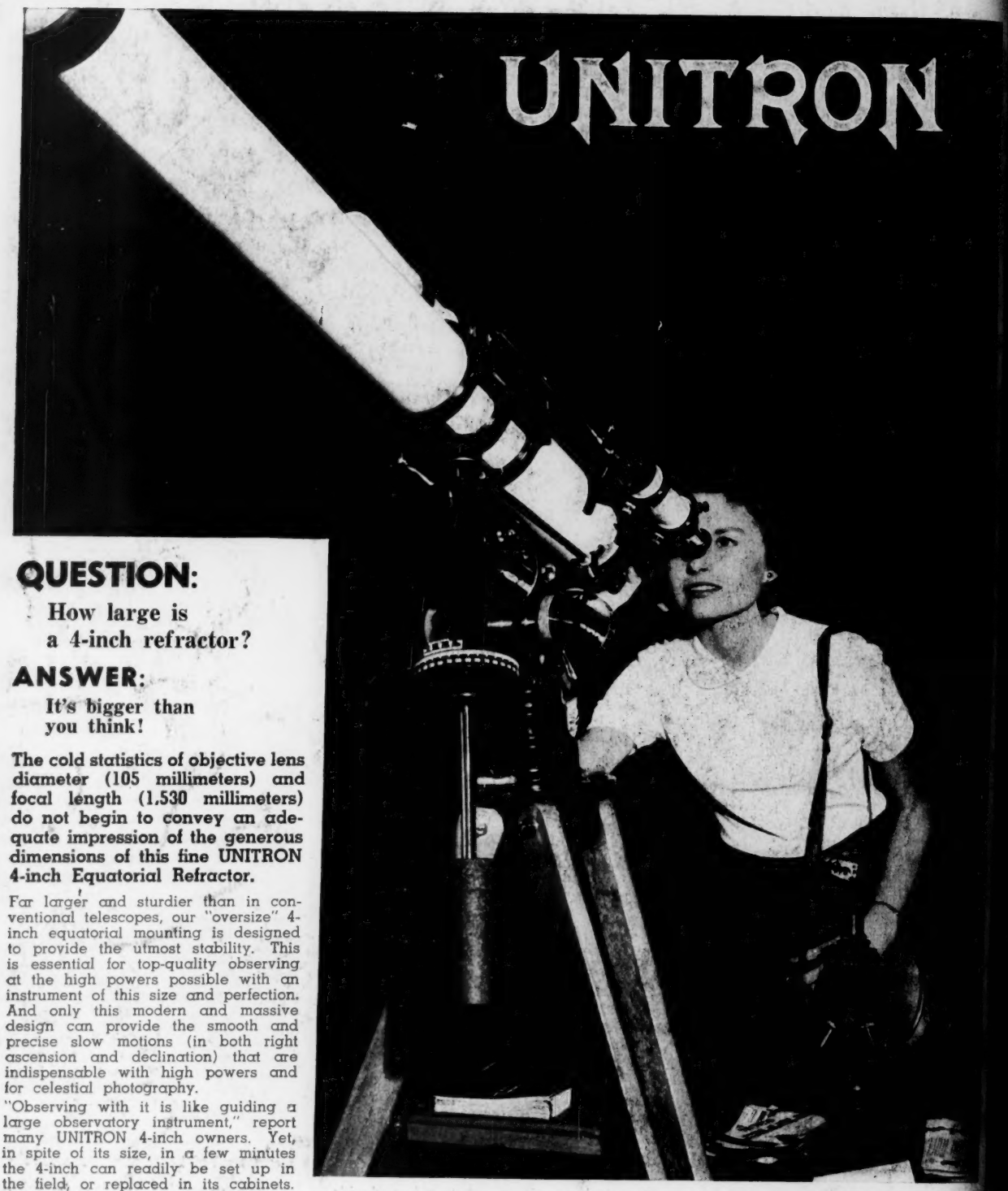
The sky as seen from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of September, respectively.

STARS FOR SEPTEMBER

DURING September evenings, the striking constellation of Cygnus, or the Northern Cross, is nearly overhead. In the myths of the ancient Greeks, this asterism represented the swan whose form the god Zeus assumed when he courted the nymph Leda. The star atlas of Bayer (1603) portrays Cygnus as a swan, with 1st-magnitude Deneb in its tail, Delta (δ) and Zeta (ζ) Cygni in its wings, and 3rd-magnitude Albireo in the swan's head. This last star is a double that can be split in good field glasses, and whose color contrast of gold and blue is a fine sight in any telescope.

Cygnus lies athwart one of the richest and brightest portions of the Milky Way. On a moonless night a great, dark rift in the Milky Way, dividing it into two parallel star-spangled streamers, can be seen extending from Cygnus southward into Aquila. This rift is the effect of a vast cloud of interstellar dust that dims the myriads of stars lying beyond it.

To the south is the constellation of Aquila, the Eagle. It contains the well-known variable star, Eta (η) Aquilae. This is a Cepheid, a pulsating star, that runs through its cycle of light changes in seven days. When brightest, it is a good match for Delta (δ) Aquilae; four days later it becomes nearly a magnitude fainter, a change readily detectable by the naked-eye observer. Ever since the variability of Eta Aquilae was discovered nearly two centuries ago, its light fluctuations have recurred with great fidelity.



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The cold statistics of objective lens diameter (105 millimeters) and focal length (1,530 millimeters) do not begin to convey an adequate impression of the generous dimensions of this fine UNITRON 4-inch Equatorial Refractor.

Far larger and sturdier than in conventional telescopes, our "oversize" 4-inch equatorial mounting is designed to provide the utmost stability. This is essential for top-quality observing at the high powers possible with an instrument of this size and perfection. And only this modern and massive design can provide the smooth and precise slow motions (in both right ascension and declination) that are indispensable with high powers and for celestial photography.

"Observing with it is like guiding a large observatory instrument," report many UNITRON 4-inch owners. Yet, in spite of its size, in a few minutes the 4-inch can readily be set up in the field, or replaced in its cabinets.

Optically speaking, the UNITRON 4-inch duplicates the performance of considerably larger telescopes of other types. With the long focal length, high magnifications of planetary and lunar images are obtained with low-power eyepieces. Moreover, there are no mirrored surfaces to become oxidized, no secondary optics to cause diffraction patterns, and no folding of the light back on itself through turbulent air with consequent loss of definition. No wonder then, that you see more and see better with a UNITRON Refractor.

MODEL 152 COMPLETE as illustrated with equatorial mounting and tripod, 10x view finder, 6 eyepieces, sunscreen, sunglass, solar aperture diaphragm, star diagonal, erecting prism system, dewcap, dustcap, pocket eyepiece case, wooden cabinets, etc. **Only $785**

MODEL 155 as above but with 2.4" photographic guide telescope with star diagonal and crosshair eyepiece. **Only $890**

MODEL 150—4" refractor with altazimuth mounting **Only $465**

See pages 387 and 399 for catalog information, terms, and news of other models of UNITRON Refractors.

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